# PROCEEDINGS

OF THE

# LITERARY AND PHILOSOPHICAL SOCIETY

OF

# LIVERPOOL,

DURING THE

SEVENTY-FIFTH SESSION, 1885–86.

No. XL.

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## PAPERS PRINTED.

## SESSION LXXV, 1885–86.

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Rev. J. Polack, B.A.
John Lovell.
R. McLintock.

## ORDINARY MEMBERS,

ON THE SOCIETY'S ROLL AT THE CLOSE OF THE 75TH SESSION,

CORRECTED TO SEPTEMBER, 1886.

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*Life Members are Marked with an Asterisk.*

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|---|---|---|
| March 24, 1879 | Alexander, William, M.D., 102, *Bedford-street South.* |
| Nov. 1, 1880 | Allen, Francis B., 88, *Newsham Drive, Newsham Park.* |
| Nov. 12, 1877 | Allman, G. W., 4, *Ullet road, Prince's Park.* |
| March 7, 1864 | Archer, F., B.A., Trin. Col., Cantab., 14, *Cook-street,* and *Boundary Cottage, Little Crosby.* |
| Nov. 29, 1880 | Armour, Rev. S. C., M.A., Merchant Taylors' School, *Crosby.* |
| Nov. 18, 1876 | Ball, Geo. Hy., 57, *Hope-street.* |
| April 20, 1874 | Barton, Rev. John, M.A., *Vicarage, Rainhill.* |
| Nov. 15, 1869 | Beer, Joseph B. de, *Northern Assurance-chambers, Tithebarn-street.* |
| Feb. 22, 1875 | Bellew, Thomas A., 28, *Canning-street.* |
| Jan. 27, 1879 | Beloe, Charles H., *Lezayre, Livingston Drive, Sefton Park,* and 18, *Harrington-street.* |
| Dec. 10, 1866 | Benas, Baron Louis, *Prince's Avenue.* |
| Jan. 9, 1882 | Benas, Phineas A., 74, *Upper Parliament-street.* |
| Feb. 6, 1882 | Birchall, Charles, 82, *Castle-street.* |
| Jan. 25, 1864 | Birchall, James, *Kirkdale,* HON. SECRETARY. |
| Oct. 19, 1868 | Bower, Anthony, *Vauxhall Foundry,* and *Bowersdale, Seaforth.* |

Nov. 2, 1885 Brannigan, R. A., M.D., 109, *Upper Parliament-street.*
Jan. 25, 1886 Beckett, G., 31B, *Hope-street.*
Feb. 6, 1882 Bradley, A. C., M.A., Professor of Modern Literature, University College, 118, *Canning-street.*
Jan. 27, 1878 Bremner, H. H., B.A., *Municipal-buildings, Dale-street.*
Oct. 18, 1869 Brown, J. Campbell, D Sc., F.C.S., Professor of Chemistry, University College.
Oct. 30, 1876 Bulman, Richard, 18, *Chapel-street.*
April 18, 1864 Burne, Joseph, *Royal Insurance Office*, 1, *North John-street.*
Oct. 17, 1881 Burton, Dr., 64, *Rodney-street.*
*May 1, 1848 Byerley, Isaac, F.L.S., F.R.C.S., *Seacombe.*
Jan. 7, 1884 Calder, Miss Fanny, 47, *Canning-street.*
Nov. 3, 1862 Cameron, John, M.D., F.R.C.P., Physician to the Southern Hospital, 4, *Rodney-street.*
March 4, 1872 Carter, W., M.D., B.Sc., LL.B. (Lond.), F.R.C.P. (Lond.), 74, *Rodney-street*, PRESIDENT.
Dec. 2, 1861 Chadburn, William, 71, *Lord-street.*
Nov. 2, 1885 Conway, W. M., M.A., Roscoe Professor of Art, University College.
Oct. 18, 1869 Cook, Henry James, *Byrom-street.*
Dec. 13, 1875 Cowell, Peter, Free Library, *William Brown-street.*
Jan. 7, 1884 Cradock, Miss, L.K.Q.C.P.I., 29, *Catherine-street.*
Oct. 6, 1868 Crosfield, William, *Stanley-street*, and 16, *Alexandra Drive, Ullet-road.*
Jan. 7, 1884 Currie, John, *Bank of Liverpool, Water-street.*
Feb. 22, 1886 Currie, Luke, 8, *Lord-street.*
March 8, 1886 Darbyshire, R. D., F.G.S., *Victoria Park, Manchester.*
Nov. 12, 1883 Daly, Chas., *Knowsley-buildings.*
Nov. 12, 1866 Davies, E., F.C.S., F.I.C., The Laboratory, Royal Institution, 88, *Seel-street*, EX-PRESIDENT.

Dec. 10, 1883 Davey, Wm. J. (Messrs. Elder, Dempster & Co.), 20, *Castle-street*, and 24, *Brompton-avenue*.

Oct. 1, 1866 Dawson, Thomas, 26, *Rodney-street*.

Nov. 3, 1879 Dopson, Daniel, L.D.S., R.C.S.I., 4, *Oxford-street*.

Nov. 1, 1875 Doyle, Jas. F., 4, *Harrington-street* and *Merton-road, Bootle*.

Jan. 23, 1848 Drysdale, John James, M.D. Edin., M.R.C.S. Edin., 36, *Rodney-street*, Ex-President.

*Nov. 27, 1848 Edwards, J. B., Ph.D. Gies, F.C.S., Professor Medical Faculty of Bishop's College, *Montreal*.

March 21, 1870 Edwards, Edward E. (Smith, Edwards & Co.). *Adelaide-buildings*, 4, *Chapel-street*.

Oct. 15, 1883 Edwards, Frederick Wilkinson, 2, *Canada Dock*, and *Fairhope*, *Victoria Park*, *Walton*

April 7, 1862 English, Charles J., 23, *Oldhall-street*, and 26, *Falkner-square*.

*Dec. 13, 1852 Ferguson, William, F.L.S. F.G.S., *Kinmundy House, near Mintlaw, N.B.*

*Mar. 19, 1855 Foard, James Thomas, 42, *John Dalton-street, Manchester*.

Jan. 12, 1874 Frost, John Pownall, 10, *North John-street*.

Nov. 12, 1877 Galley, Jno., 8, *Newstead-road*.

Nov. 13, 1882 Gardner, Willoughby, 18c, *Exchange-buildings*.

Jan. 26, 1885 Gaskell, W. Frankland, 75. *Mount Pleasant*.

*Feb. 6, 1854 Gee, Robert, M.D., Heidelb., M.R.C.P., Lecturer on Diseases of Children, Royal Infirmary School of Medicine; Physician Workhouse Hospital, 5, *Abercromby-square*.

Nov. 26, 1883 Gibson, R. J. Harvey, M.A., 10, *Wellington-street, Waterloo*.

March 20, 1882 Gill, James, *Sailors' Home*, and 2, *Beech-mount, Beech-street*.

Oct. 29, 1877 Green, Robt. Frederick, 66, *Whitechapel*, Hon. Librarian.

Oct. 29, 1883 Green, Charles H. (Messrs. Green, Hill & Co.) 7, *York-street*.

Nov. 16, 1874 Guthrie, Malcolm, 2, *Parkfield-road*, HONORARY TREASURER.

Oct. 29, 1888 Guthrie, Mrs., 2, *Parkfield-road.*

Jan 22, 1855 Hakes, James, F.R.C.S., *Latrigg, Aigburth-road.*

Oct. 18, 1875 Hale, Philip A., *Bank of England, Castle-street.*

Nov. 16, 1885 Halhed, W. B. (Baring Bros.) *Sunnyside, Prince's Park.*

*Jan. 21, 1856 Hardman, Lawrence, 35, *Rock Park, Rock Ferry.*

Dec. 10, 1888 Hargreaves, Jas., F.C.S., F.A.S., *Peel House-lane, Farnworth-by-Widnes.*

Dec. 13, 1875 Harpin, E., 46, *Onslow-road, Elm Park, Fairfield.*

Jan. 25, 1886 Harries, W. J., 17, *Church-street, Egremont.*

Nov. 30, 1874 Harvey, Henry, M.B., 57, *Wavertree-terrace, Picton-road, Wavertree.*

Feb. 6, 1865 Hassan, Rev. E., 2, *Olive Mount, Wavertree.*

Nov. 13, 1865 Hayward, John William, M.D., 117, *Grove-street.*

Oct. 16, 1882 Herdman, W. A., D.Sc., F.L.S., F.R.S.E., Professor of Natural History, University College, 99, *Bedford-street*, VICE-PRESIDENT.

March 7, 1880 Hess, Leonard O., 51, *Bedford-street.*

Nov. 4, 1872 Hicks, John Sibley, F.R.C.S., F.L.S., 2, *Erskine-street*, VICE-PRESIDENT.

March 22, 1869 Higgin, Thomas, F.L.S., 33, *Tower-buildings*, and *Huyton.*

Dec. 28, 1846 Higgins, Rev. H. H., M.A. Cantab., F.C.P.S., *Rainhill*, EX-PRESIDENT.

Jan. 13, 1879 Higgins, Henry Longuet (Messrs. Simpson & North), 3, *Water-street.*

Oct. 20, 1884 Highmore, J. Henry, 27, *Prospect Vale.*

Nov. 16, 1868 Holden, Adam, 48, *Church-street*, and 2, *Carlton-terrace, Milton-road.*

March 9, 1868 Holme, James, 10, *Huskisson-street*, and *Eldon-chambers, South John-street.*

Nov. 30, 1874 Holme, Rev. Arthur P., *Tattenhall, near Chester.*

*Dec. 14, 1862 Holt, Robert Durning, 6, *India-buildings*, and 29, *Edge-lane.*

Jan. 21, 1884 Hope, E. W., M.D., 85, *Bedford-street*, and *Municipal Offices.*

Nov. 4, 1878 Howie, J. Muir, M.B., 86, *Prince's-road.*

March 10, 1879 Hughes, John W., *Hornby-road, Wavertree.*

Feb. 20, 1882 Hunter, Hugh, 25A, *Duke-street.*

*Nov. 18, 1854 Hunter, John, Member Historic Society, Pennsylvania, *Halifax, Nova Scotia.*

*April 29, 1850 Ihne, William, Ph.D.Bonn, *Villa Felseck, Heidelberg*, Ex-President.

Jan. 26, 1868 Johnson, Richard C., F.R.A.S., 16, *Cook-street*, and 19, *Catherine-street.*

Feb. 24, 1868 Jones, Charles W., *Field House, Wavertree.*

*April 4, 1852 Jones, Morris Charles, F.S.A., F.S.A. Scot., *Gungrog, Welshpool.*

Nov. 1, 1869 Kinsman, W. N., *The Tower, Sandfield Park.*

Nov. 2, 1885 Krusman, Rev. Gerhardt, 8, *Falkner-street.*

Nov. 8, 1878 Lee, Hamilton (Messrs. Lee & Nightingale), *North John-street.*

*Dec. 11, 1871 Leigh, Richmond, M.R.C.S., L.S.A., Physician to St. George's Hospital for Diseases of the Skin, 15, *St. James's Road.*

Nov. 13, 1882 Levy, Philip S., 24, *North John-street.*

Nov. 3, 1884 Lewin, Walter, *Bebington.*

Nov. 14, 1881 Lloyd, Richard J., M.A., *Lombard-chambers, Bixteth-street.*

Oct. 31, 1881 Lodge, Oliver J., D.Sc., Professor of Physics, University College, 26, *Waverley-road, Sefton Park.*

Dec. 1, 1879 Long, Rev. R. E., B.A., *Cambridge House, Upper Parliament-street.*

Feb. 7, 1881 Lovell, John, 17, *Gambier-terrace*, and "Mercury" Office, *Wood-street.*

Oct. 2, 1882 MacCunn, John, M.A., Professor of Philosophy and Political Economy, University College, *Ashton-street.*

Dec. 1, 1884 Mackay, Professor of History, University College, *Ashton-street.*

Jan. 23, 1882 Marcus, Heinrich, *Trafford-chambers*, 58, *South John-street.*

Jan. 26, 1885 Mark, Thomas Wm., *Woolton Mount*, *Woolton.*

Nov. 14, 1870 Marples, Joseph, 28, *Leece-street*, and *Carlton-road*, *Tranmere.*

Nov. 17, 1878 Marples, Josiah, *Melvill-chambers*, *Lord-street*, and *Broomfield*, *Egremont.*

Jan. 21, 1889 Martin, Studley, 27, *Brown's-buildings*, and 177, *Bedford-street South.*

Oct. 20, 1879 McArthur, Charles, 18F, *Exchange-buildings.*

March 23, 1874 McCulloch, D. B., 23, *Queen-buildings*, *Dale-street.*

Oct. 17, 1881 McLintock, R., 8, *Balmoral-road.*

Oct. 30, 1882 McMaster, John Maxwell (Messrs. J. B. Wilson, Dean & McMaster), 22A, *Lord-street.*

Oct. 15, 1888 Mead, A. J., B.A., Wallasey Grammar School, *Earleston-road*, *Liscard.*

Nov. 17, 1878 Mellor, James, Jun., *Weston*, *Blundellsands.*

Dec. 14, 1874 Mellor, John, *Grosvenor House*, *Crosby-road South*, *Waterloo.*

Oct. 20, 1879 Mellor, Thomas, *Edgewater*, *Blundellsands.*

Feb. 8, 1886 Melly, W. R., 90, *Chatham-street.*

Nov. 16, 1885 Moore, G. F., 25, *Marlborough-road*, *Tuebrook.*

Oct. 31, 1859 Moore, Thomas John, Corr. Mem. Z.S.L., Curator Free Public Museum, *William Brown-street.*

Nov. 1, 1880 Morrow, John, *Lynwood*, *Priory-road*, *Broad Green.*

March 6, 1882 Morton, George Henry. 122, *London-road.*

Jan. 8, 1855 Morton, Geo. Highfield, F.G.S., 209, *Edge-lane.*

April 16, 1849 Moss, Rev. John James, B.A., *East Lydford Hall, Somerton, Somerset.*

Oct. 29, 1850 Mott, Albert Julius, F.G.S., *Crickley Hill, Gloucester*, Ex-President.

Oct. 31, 1881 Mount, Ed., *Oaklands, Aughton, near Ormskirk.*

*Oct. 21, 1867 Muspratt, E. K., *Seaforth Hall, Seaforth.*

Oct. 20, 1856 Nevins, John Birkbeck, M.D. Lond., M.R.C.S., late Lecturer on Materia Medica, Royal Infirmary School of Medicine, 3, *Abercromby-square*, Ex-President.

Feb. 6, 1865 Newton, John, M.R.C.S., 9, *Westcliffe-road, Southport.*

Jan. 21, 1884 Nicholson, Edward, F.C.S., F.I.C., Surgeon-Major Army Retired, 78, *Bedford-street.*

Feb. 18, 1878 Nicholson, Robert, 11, *Harrington-street.*

Nov. 2, 1868 Norrie, Rev. B. A. W., M.A. Cantab., The College School, *Huyton.*

*Oct. 15, 1855 North, Alfred, 1, *Hanover-terrace, Notting-hill, London, W.*

Dec. 18, 1866 Owen, Peter (Farnworth & Jardine), *Liverpool and London Chambers.*

Nov. 2, 1885 Oulton, Wm., *Gateacre*, and *Albert-buildings*, 22, *Preeson's Row.*

Nov. 2, 1874 Palmer, John Linton, F.S.A., F.R.G.S., Fleet Surgeon, R.N., 24, *Rock Park, Rock Ferry.*

Oct. 20, 1884 Parker, Geo. (Messrs. Haddocks & Co., C16, *Exchange-buildings*), 15, *Normanby-street.*

Nov. 18, 1882 Paton, Rev. William, *The Ferns, Parkside, Nottingham.*

Jan. 9, 1871 Patterson, J., 16, *Devonshire-road, Prince's Park.*

Nov. 4, 1861 Philip, Thomas D., 49, *South Castle-street*, and *Holly-road, Fairfield.*

Dec. 28, 1846 Picton, Sir James Allanson, F.S.A., Chairman of the Library and Museum Committee, 11, *Dale-street*, and *Sandy Knowe*, *Wavertree*, Ex-President.

Feb. 24, 1879 Plastow, William, 383, *Scotland-road.*

Jan. 21, 1884 Polack, Rev. J., B.A., 88, *Falkner-street.*

*Jan. 22, 1866 Raffles, William Winter, 84, *Belsize Park Gardens*, *London*, *W.*, and *Glan-y-mor*, *Penmaenmawr.*

Nov. 12, 1860 Rathbone, Philip H., *Greenbank Cottage*, *Wavertree.*

March 24, 1862 Rathbone, Richard Reynolds, *Beechwood House*, *Grassendale.*

*Nov. 17, 1851 Redish, Joseph Carter, Lyceum, *Bold-street.*

Oct. 31, 1881 Rendall, G. H., M.A., Principal of University College, 70, *Bedford-street.*

Oct. 31, 1881 Rennie, J. W., 54, *Foxhill-street.*

Nov. 29, 1869 Roberts, Isaac, F.G.S., F.R.A.S., *Kennessee*, *Maghull*, Vice-President.

Dec. 4, 1876 Roberts, Richard (Messrs. Roberts & Son), 18, *Hackins-hey*, and *Mossley-hill.*

Oct. 29, 1877 Rosenheim, Jos. C., *Sunnybank*, *Prince's Park*, and C14, *Exchange-buildings.*

April 18, 1854 Rowe, James, 14, *South Castle-street*, and *Leyfield Grange*, *West Derby.*

Jan. 22, 1872 Russell, Edward R., M.P., "Daily Post" Office, *Victoria-street*, and 6, *Abercromby-square*, Ex-President.

Feb. 18, 1878 Russell, W., Compton Hotel, *Church-street.*

Feb. 18, 1884 Rutherford, John, LL.B. Lond., 4, *Harrington-street.*

Nov. 12, 1883 Rutherford, Wm. Watson (Messrs. Miller, Peel, Hughes & Co.), *Eberle-street.*

April 7, 1862 Samuel, Harry S., 80, *Onslow Gardens*, *South Kensington*, *London.*

Oct. 18, 1880 Schack-Sommer, Dr. (Messrs. Crosfield, Barrow & Co.), 323, *Vauxhall-road.*

March 19, 1883 Selwyn, Rev. E. C., M.A., The College, *Shaw-street*, and *Dingle Bank*.
March 19, 1866 Sephton, Rev. John, M.A., *Liverpool Institute*.
Oct. 15, 1883 Sephton, Mrs., 90, *Huskisson-street*.
Dec. 2, 1878 Serjeant, Jno., 128, *London-road*.
Jan. 7, 1878 Shearer, George, M.D., 178, *Upp. Parliament-st*.
Oct. 18, 1875 Simpson, James, 10, *Rumford-place*.
Oct. 31, 1881 Smith, A. T., Jun., 18, *Bentley-road*, *Prince's Park*.
Dec. 10, 1866 Smith, Elisha (Messrs. Henry Nash & Co.), 12, *Tower-buildings North*.
April 4, 1870 Smith, James, 9, *Lord-street*, and *Ribblesdale Villas*, 22, *Merton-road*, *Bootle*.
Feb. 23, 1863 Smith, J. Simm, 1, *Warham-road*, *Croydon*.
April 20, 1874 Snow, Rev. T., M.A., *St. Mary's*, *Highfield-street*.
Nov. 12, 1860 Spence, Charles, 7, *Tithebarn-street*.
Feb. 10, 1862 Spence, James, *London*.
Nov. 18, 1878 Steel, Richard, 18, *Hackins-hey*, Ex-President.
Feb. 19, 1883 Steeves, Gilbert M., 24, *Falkner-street*.
Oct. 29, 1883 Stretch, Wm. Knowles, 9, *South Hill-road*.
Nov. 28, 1881 Sumner, R. M., 50a, *Lord-street*.
Feb. 18, 1878 Symes, Charles, Ph.D., *Ellerslie*, *West Derby*.
April 17, 1882 Tapscott, W. W., 39, *Oldhall-street*, and 41, *Parkfield-road*, *Aigburth*.
Feb. 18, 1878 Taylor, Geo., 28, *Seel-street*.
*Feb. 19, 1865 Taylor, John Stopford, M.D. Aberd., F.R.G.S., *Rivelin*, *Richmond Park*, *Anfield-road*.
Oct. 21, 1878 Thomson, J. W., B.A. Lond. and Victoria, 22, *Lord-street*.
Oct. 30, 1882 Thomson, W. J., *Exchange-buildings*, and *Ghyll-bank*, *St. Helens*.
Nov. 17, 1850 Tinling, Chas., *Victoria-street*, and 29, *Onslow-road*, *Elm Park*.
Dec. 4, 1876 Torpy, Rev. Lorenzo, M.A., *Setubal*.
*Feb. 19, 1844 Turnbull, James Muter, M.D. Edin., M.R.C.P., 86, *Rodney-street*.

Oct. 21, 1861 Unwin, William Andrews, 11, *Rumford-place.*

Oct. 20, 1879 Veevers, Samuel, *Broad Green*, and 12A, *Manchester-buildings*, *Tithebarn-steeet.*

Nov. 16, 1885 Veitch, Jas., M.A., 161, *Chatham-street.*

Nov. 15, 1880 Vicars, John, 29, *Seel-street.*

Feb. 24, 1879 Walker, R. S., J.P., Resident Secretary, General Insurance Co., 8, *Brunswick-street.*

Feb. 19, 1877 Wallace, John, M.D., *Gambier-terrace.*

Jan. 27, 1862 Walmsley, Gilbert G., 50, *Lord-street.*

Nov. 17, 1884 Watts, E. G. B., 5, *Canada-dock.*

Nov. 17, 1884 Wortley, Wm., *Walton Grange*, *Walton.*

Jan. 9, 1865 Walthew, William, *Phœnix Chambers*, and *Vine Cottage*, *Aughton.*

Oct. 30, 1876 Weightman W. Arthur (Messrs. Field & Weightman), *Talbot Chambers*, 5, *Fenwick-street*, *W.*

Dec. 2, 1861 Weightman, William Henry, *Minster-buildings*, *Church-street*, and *Camidge-road*, *Seaforth.*

Nov. 13, 1882 Wightman, William, 17, *Park Way.*

Nov. 2, 1874 Wolf, Jas. O. de (Messrs. T. C. Jones & Co.), 26, *Chapel-street.*

Nov. 14, 1870 Wood, John J., 20, *Lord-street.*

Nov. 13, 1876 Yates, Edward Wilson, 37, *Castle-street.*

Nov. 2, 1874 Young, Henry, *South Castle-street.*

Oct. 30, 1882 Zicaliotti, Alexander, 60, *Cable-street*, and 7, *Grove Park.*

## HONORARY MEMBERS.

LIMITED TO FIFTY.

1.—1836 The Most Noble William, Duke of Devonshire, K.G., M.A., F.R.S., D.C.L., F.G.S., etc., Chancellor of the University of Cambridge *Chatsworth, Derbyshire*, and 78, *Piccadilly, London, W.*

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3.—1840 James Nasmyth, F.R.S., *Penshurst, Kent.*

4.—1844 T. B. Hall, *Crane House, Yarmouth.*

5.—1844 Peter Rylands, M.P., *Warrington.*

6.—1850 The Rev. Canon St. Vincent Beechy, M.A., Rector of *Hilgay, Norfolk.*

7.—1851 The Rev. Robert Bickersteth Mayor, B.D., Rector of *Frating, Essex.*

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9.—1865 The Right Rev. T. N. Staley, D.D., late Bishop of Honolulu, Vicar of *Croxhall, Staffordshire.*

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17.—1870 Professor Brown Sequard, M.D.

18.—1870 John Gwyn Jeffreys, F.R.S., *Ware Priory, Herts.*

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20.—1870 Professor John Tyndall, LL.D., F.R.S., etc., Royal Institution, *London.*

21.—1870 The Rev. Christian D. Ginsburg, LL.D., *Binfield, Bracknell, Berks.*, Ex-President.

22.—1874 Professor Alexander Agassiz, Director of the Museum of Comparative Zoology, *Harvard, Cambridge, Massachusetts.*

23.—1874 Professor Frederick H. Max Müller, LL.D., *Oxford.*

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26.—1877 The Earl of Crawford and Balcarres, F.R.S., Foreign Secretary of R.A.S., etc., 9, *Grosvenor-square, London.*

27.—1877 Albert C. N. Günther, M.A., M.D., Ph.D., British Museum.

28.—1877 Adolphus Ernst, M.D., Principal of the Department of Science, Philosophy, and Medicine, University of Caracas.

29.—1877 Dr. Leidy, Academy of Science, *Philadelphia.*

30.—1877 Dr. Franz Steindachner, Royal and Imperial Museum, *Vienna.*

31.—1877 The Rev. H. B. Tristram, M.A., LL.D., F.R.S., Canon of Durham, The College, *Durham.*

82.—1881 H. J. Carter, F.R.S., *The Cottage*, *Budleigh Salterton*, *Devon*.

83.—1881 The Rev. Thomas Hincks, B.A., F.R.S., *Stokeleigh*, *Leigh Woods*, *Clifton*, *Bristol*.

84.—1881 The Rev. W. H. Dallinger, LL.D., F.R.S., P.R.M.S., Wesley College, *Sheffield*.

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LIMITED TO THIRTY-FIVE.

1.—1867 J. Yate Johnson, *London*.
2.—1867 R. B. N. Walker, F.R.G.S., F.G.S., *West Africa*.
3.—1868 Rev. J. Holding, M.A., F.R.G.S., *London*.
4.—1868 George Hawkins, *Colombo*, *Ceylon*.
5.—1868 J. Lewis Ingram, *Bathurst*, *River Gambia*.
6.—1869 George Mackenzie, *Cebu*, *Philippine Islands*.
7.—1870 The Venerable Archdeacon Hughes-Games, D.C.L., *Isle of Man*.
8.—1874 Samuel Archer, Surgeon-Major, *Singapore*.
9.—1874 Coote M. Chambers, *Burrard's Inlet*, *British Columbia*.
10.—1874 Edwyn C. Reed, *Santiago de Chili*.
11.—1874 Millen Coughtrey, M.D., *Dunedin*, *Otago*, *New Zealand*,
12.—1875 Robert Gordon, Government Engineer, *British Burmah*.
13.—1877 Edward Dukinfield Jones, C.E., *Sao Paulo*, *Brazil*.
14.—1877 Miss Horatio K. F. Gatty, *Altrincham*.
15.—1877 Dr. Allen, *Jamaica*.
16.—1877 Dr. George Bennett, *Sydney*.
17.—1877 Dr. David Walker, *Benicia*, *U.S.A*.
18.—1883 Wm. Henry Finlay, *Cape Town Observatory*.
19.—1884 Rev. W. G. Lawes, *New Guinea*.
20.—1884 A. W. Crawford, *Oakland*, *California*.
21.—1884 John Greenwood, Mining Engineer, *Melbourne*.
22.—1884 Robert Abraham English, *Simla*.

# ASSOCIATES.

LIMITED TO TWENTY-FIVE.

1.—Jan. 27, 1862 Captain John H. Mortimer, "America." (Atlantic).

2.—Mar. 24, 1862 Captain P. C. Petrie. (Atlantic.)

3.—Feb. 9, 1863 Captain John Carr, ship "Scindia." (Calcutta.)

4.—Feb. 9, 1863 Captain Charles E. Price, R.N.R., ship "Cornwallis." (Calcutta and Sydney.)

5.—April 20, 1863 Captain Fred. E. Baker, ship "Niphon." (Chinese Seas.)

6.—Oct. 31, 1864 Captain Thomson, ship "Admiral Lyons." (Bombay.)

7.—April 18, 1865 Captain Alexander Cameron, ship "Staffordshire." (Shanghai.)

8.—Dec. 11, 1865 Captain Walker, ship "Trenton."

9.—Mar. 28, 1868 Captain David Scott.

10.—Oct. 5, 1868 Captain W. H. Cawne Warren, ship "Bedfordshire."

11.—April 7, 1884 Captain G. Griffith Jones, barque "Hermine."

## VOLUMES PRESENTED TO THE LIBRARY DURING THE SEVENTY-FIFTH SESSION, 1885–1886.

### A.

Asiatic Society of Bengal. Proceedings, 1883–85, no. 8; Journal, 1884–85; vol. liv, part 2.

Arts, Society of. Journal, 1885; nos. 1787–89.

Architects, Royal Institution of British. Proceedings and Transactions, 1884–85; Journal, vol. ii, no. 2; 6–10.

Asiatic Society, Royal, of Great Britain and Ireland. Journal, vol. xvii, new series, 1885, part 2; vol. xviii, part 1.

Astronomical Society, Royal. Memoirs, 1884, vol. xlviii, part 2; Monthly Notices, nos. 6–8; vol. xlvi; vol. xlv, no. 9.

Archæologia. Vol. xlviii.

Archæological Journal. Vol. xli, no. 162.

Antiquaries, Society of. List, 1885; Proceedings, vol. ix, second series.

Antiquaries of London, Society of. Proceedings, vol. x, nos. 2–3.

Asiatic Society, Royal, Bombay branch. Journal, no. 43; extra no. (being Prof. Peterson's Report on Search for Sanskrit MS.)

Anthropological Institute of Great Britain and Ireland. Journal, vol. xv, nos. 1–3.

Antiquarians of the North, Royal Society of. Copenhagen. Memoirs, 1885.

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Arts and Sciences, American Academy of. Proceedings, vol. xii; vol. xiii, new series, part 1.

Anthropological Society. Washington, D.C. Women's Organization, 1885.

Arts and Sciences, Academy of. Connecticut. Transactions, vol. vi, part 2.

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Astronomical Observations, National. Mexico. Sixth Annual Report.

Arts, Royal Scottish Society of. Transactions, vol. ii, part 3.

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Antiquaires de l'ouest, Soc. des. Poictiers. Mem., vol. vii.

Archæological and Natural History Society. Somersetshire. Proceedings, vol. xxx.

Antiquarian. Canadian Vol. viii, no. 1.

Abbeville Soc. d'emulation, Bulletin de. Proceedings, verb.

Abhandlungen, Sage und Furschung, by F. Ohlenschlager.

## B.

Botanic Garden, Royal, Edinburgh, 1878.

Belgium Royal Academy. Annual Bulletin, 1884–85, vols. vi–viii.

Botanical Society. Transactions and Proceedings, vols. xv, xvi.

Births, Marriages, and Deaths, &c. State of Massachusetts, Forty-third Report.

Botanical Society of Edinburgh. Transactions, vol. xvi, part 2.

## C.

Cornwall Royal Institution. Journal, part 3; vol. viii.

Centenary Review, 1784–1883.

Canadian Institute. Proceedings, vols. i–iii; Journal, vol. i, new series, parts 1, 2.

Chemical Society, Journal. Abstract of Proceedings, &c.

Copenhagen Royal Academy of Bulletins, 1883–5.

Chemists' Association, Liverpool. Transactions, Session 1884–85.

Canadian Institution, Toronto. Proceedings, February, 1886.

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Cherbourg, Société Nationale des Sciences Naturelles. Catalogue, 2nd part; Memoirs, vol. xxiv.

## D.

Dunecht Observatory. Publications, vol. iii; Mauritius Expedition, 1874.

Davenport (Iowa) Academy. Proceedings, vol. iii.

Danish Vedenskabernes Selskabs, no. 2, 1885.

## E.

East India Association. Journal, vol. xvii, nos. 4, 5; vol. xviii, no. 2.

Engineers, Institute of Civil. Minutes, vol. lxxxiii.

Essex Field Club. Transactions, vol. iv, part 1; Journal, vol. iv, part 1; Appendix.

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Engineers, Institution of Civil. Minutes, vols. xxix–xxxi; Charter Lectures, 1883–84.

Essex Institute (Salem, Mass.) Bulletins, vols. xv, xvi; Catalogue of Publications, 1884.

## F.

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Franklin Institute, Boston. Journal, nos. 719–23.

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## G.

Geological Society, Liverpool. Proceedings Twenty-sixth Session 1884–85.

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Geological Society, Royal Cornwall. Transactions, vol. x, part 7.

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Geographical Magazine, Scottish. Vol. i, nos. 1–8.
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H.

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I.

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Institution of Great Britain, Royal. Proceedings, vol. xi, part 2; List of Members, 1885.

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## L.

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## M.

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## N.

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## O.

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## P.

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R.

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S.

Science Society, Dulwich College. Seventh Annual Report.

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Statistical Society. Journal, vol. xlviii, part 2–4; Jubilee Vol.

Science Gossip, Hardwicke's. To date.

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Volk-Songs, translated by H. Phillips, Jun., Philadelphia.

W.

Wissenschaften, Akademie der, Vienna. Proceedings, vols. civ–vi, no. 1, 1886.

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# SOCIETIES, ACADEMIES, AND OTHER INSTITUTIONS

TO WHICH THIS VOLUME IS PRESENTED.

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## Great Britain and Ireland.

| | |
|---|---|
| *Aberdeen* - - - - | The Dun-Echt Observatory. |
| *Alnwick* - - - - | The Berwickshire Naturalists' Field Club. |
| *Bath* - - - - - | The Natural History and Antiquarian Field Club. |
| *Belfast* - - - - | The Naturalists' Field Club. |
| *Belfast* - - - - | The Natural History and Philosophical Society. |
| *Birkenhead* - - - | The Free Public Library. |
| *Birkenhead* - - - | The Literary and Scientific Society. |
| *Birmingham* - - - | The Philosophical Society. |
| *Bristol* - - - - | The Naturalists' Society. |
| *Buckhurst Hill* - - | The Epping Forest Naturalists' Field Club. |
| *Chester* - - - - | The Society of Natural Science. |
| *Cambridge* - - - | The Cambridge Union. |
| *Dublin* - - - - | The Royal Irish Academy. |
| *Dublin* - - - - | The Royal Geological Society of Ireland. |
| *Dublin* - - - - | The Royal Society. |
| *Edinburgh* - - - | The Botanical Society. |
| *Edinburgh* - - - | The Geological Society. |
| *Edinburgh* - - - | The Meteorological Society of Scotland. |
| *Edinburgh* - - - | The Philosophical Institution. |
| *Edinburgh* - - - | The Royal Observatory. |
| *Edinburgh* - - - | The Royal Physical Society. |
| *Edinburgh* - - - | The Royal Scottish Society of Arts. |
| *Edinburgh* - - - | The Royal Society. |

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|---|---|
| *Falmouth* - - - | The Royal Cornwall Polytechnic Society. |
| *Glasgow* - - - - | The Philosophical Society. |
| *Glasgow* - - - - | The Geological Society. |
| *Glasgow* - - - - | The University. |
| *Greenwich* - - - | The Royal Observatory. |
| *Halifax* - - - - | The Literary and Philosophical Society. |
| *Hull* - - - - - | The Literary and Philosophical Society. |
| *London* - - - - | The Anthropological Institute. |
| *London* - - - - | The Society of Antiquaries. |
| *London* - - - - | The Royal Institute of British Architects. |
| *London* - - - - | The Society of Arts. |
| *London* - - - - | The Royal Asiatic Society. |
| *London* - - - - | The Royal Astronomical Society. |
| *London* - - - - | The British Association. |
| *London* - - - - | The British Museum. |
| *London* - - - - | The Chemical Society. |
| *London* - - - - | The Royal Geographical Society. |
| *London* - - - - | The Geological Society. |
| *London* - - - - | The Geologists' Association. |
| *London* - - - - | The Institution of Civil Engineers. |
| *London* - - - - | The East Indian Association. |
| *London* - - - - | The Linnæan Society. |
| *London* - - - - | The Meteorological Society. |
| *London* - - - - | The Society for Psychical Research. |
| *London* - - - - | The Royal Microscopical Society. |
| *London* - - - - | The Royal Medico-Chirurgical Society. |
| *London* - - - - | The Royal Society. |
| *London* - - - - | The Royal Institution. |
| *London* - - - - | The Royal Society of Literature. |
| *London* - - - - | The Statistical Society. |
| *London* - - - - | The Zoological Society. |
| *London* - - - - | The Editor of "Nature." |
| *London* - - - - | The Editor of the "Journal of Science." |
| *London* - - - - | The Editor of "Science Gossip." |
| *London* - - - - | The Editor of "The Scientific Roll." |
| *Leeds* - - - - - | The Philosophical and Literary Society. |

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| *Leeds* - - - - - | The Yorkshire Geological and Polytechnic Society. |
| *Leicester* - - - - | The Literary and Philosophical Society. |
| *Liverpool* - - - - | The Architectural and Archæological Society. |
| *Liverpool* - - - - | The Chemists' Association. |
| *Liverpool* - - - - | The Engineering Society. |
| *Liverpool* - - - - | The Geological Society. |
| *Liverpool* - - - - | The Geological Association. |
| *Liverpool* - - - - | The Historic Society of Lancashire and Cheshire. |
| *Liverpool* - - - - | The Microscopical Society. |
| *Liverpool* - - - - | The Naturalists' Field Club. |
| *Liverpool* - - - - | The Philomathic Society. |
| *Liverpool* - - - - | The Polytechnic Society. |
| *Liverpool* - - - - | The Athenæum Library and News Room. |
| *Liverpool* - - - - | The Free Public Library. |
| *Liverpool* - - - - | The Liverpool Library. |
| *Liverpool* - - - - | The Lyceum News Room. |
| *Liverpool* - - - - | The Medical Institution. |
| *Liverpool* - - - - | The Royal Institution. |
| *Liverpool* - - - - | University College. |
| *Manchester* - - - | The Literary Club. |
| *Manchester* - - - | The Literary and Philosophical Society. |
| *Manchester* - - - | Chetham Library. |
| *Manchester* - - - | The Free Public Library. |
| *Manchester* - - - | Owens College. |
| *Newcastle-on-Tyne* - | The Natural History Society of Northumberland and Durham. |
| *Oxford* - - - - | The Ashmolean Society. |
| *Oxford* - - - - | The Union Society. |
| *Penzance* - - - | The Royal Geological Society of Cornwall. |
| *Plymouth* - - - | The Plymouth Institution. |
| *Taunton* - - - - | The Somersetshire Archæological Society. |
| *Truro* - - - - | The Royal Institution of Cornwall. |
| *Watford* - - - - | The Hertfordshire Natural History Society and Field Club. |

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| *Welshpool* - - - | The Powys Land Club. |
| *Whitby* - - - - | The Literary and Philosophical Society. |

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## British Colonies and the United States.

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|---|---|
| *Bombay* - - - - | The Royal Asiatic Society. |
| *Boston* - - - - | The American Academy of Arts and Science. |
| *Boston* - - - - | The Massachusetts Board of Education. |
| *Boston* - - - - | The Massachusetts Board of Health, Lunacy, and Charity. |
| *Boston* - - - - | The Natural History Society. |
| *Boston* - - - - | The Public Library. |
| *Buffalo* - - - - | The Society of Natural Sciences. |
| *Calcutta* - - - - | The Asiatic Society of Bengal. |
| *Calcutta* - - - - | The Geological Survey of India. |
| *Cambridge* (*Mass.*) - | Harvard University. |
| *Cambridge* (*Mass.*) - | Museum of Comparative Zoology. |
| *Cambridge* (*Mass.*) - | The Peabody Museum of American Archæology and Ethnology. |
| *Chicago* - - - - | The Public Library. |
| *Davenport* - - - | The Academy of Natural Sciences. |
| *Melbourne* - - - | The Royal Society of Victoria. |
| *New Haven* - - - | The Connecticut Academy of Arts and Sciences. |
| *New York* - - - | The Academy of Sciences. |
| *New York* - - - | The Astor Library. |
| *New York* - - - | The American Geographical Society. |
| *New York* - - - | The City University. |
| *New York* - - - | The State University. |
| *New York* - - - | The State Library. |
| *New York* - - - | The American Museum of Natural History. |
| *Otago* - - - - | The University. |
| *Ottawa* - - - - | Geological and Natural History Survey. |
| *Ottawa* - - - - | The Library of Parliament. |
| *Philadelphia* - - | The Academy of Natural Sciences. |

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| *Philadelphia* - - | The American Philosophical Society. |
| *Philadelphia* - - | The Franklin Institute. |
| *Philadelphia* - - | The Pennsylvania Board of Public Education. |
| *Philadelphia* - - | The Zoological Society. |
| *Salem* - - - - | The American Association for the Advancement of Science. |
| *Salem* - - - - | The Essex Institute. |
| *San Francisco* - - | The Lick Observatory. |
| *Sydney* - - - - | The Royal Society of New South Wales. |
| *Sydney* - - - - | The Department of Mines. |
| *Toronto* - - - - | The Canadian Institute. |
| *Washington* - - - | The Department of Agriculture. |
| *Washington* - - - | The Geological and Geographical Survey of the Territories. |
| *Washington* - - - | The Naval Observatory. |
| *Washington* - - - | The Smithsonian Institution. |
| *Washington* - - - | The Department of Ordnance; the Department of the Chief of Engineers; the Department of Agriculture; the Department of the Interior. |
| *Wellington* - - - | The New Zealand Institute. |

FOREIGN.

| | |
|---|---|
| *Amsterdam* - - - | L'Academie Royale des Sciences. |
| *Berlin* - - - - | Die Akademie der Wissenschaften. |
| *Bordeaux* - - - | La Société des Sciences Physiques et Naturelles. |
| *Brussels* - - - - | L'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique. |
| *Cherbourg* - - - | La Société Nationale des Sciences Naturelles. |
| *Christiana* - - - | The University. |
| *Copenhagen* - - - | L'Académie Royale. |
| *Copenhagen* - - - | La Société Royale des Antiquaires du Nord. |

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| *Geneva* - - - - | La Société de Physique et d'Historie Naturelle. |
| *Gottingen* - - - | Die Königliche Gesellschaft der Wissenschaften. |
| *Grieswald* - - - | The University. |
| *Harlem* - - - - | La Société Hollandaise des Sciences. |
| *Helsingfors* - - - | La Société des Sciences de Finlande. |
| *Königsberg* - - - | Die Königliche Physikalisch-ökonomische Gesellschaft. |
| *Milan* - - - - | Il Reale Instituto Lombardo. |
| *Munich* - - - - | Die Königliche Akademie der Wissenschaften. |
| *Paris* - - - - - | L'Ecole Polytechnique. |
| *Presburg* - - - | Der Verein fur Natur und Heil-Kunde. |
| *St. Petersburg* - - | L'Académie Imperiale des Sciences. |
| *Stockholm* - - - | L'Académie Royal Suedoise des Sciences. |
| *Strasburg* - - - | La Bibliothèque Municipale. |
| *Strasburg* - - - | Die Kaiserliche Universitäts und Landes-Bibliothek. |
| *Tokio* - - - - - | The University. |
| *Toulouse* - - - | L'Observatoire Astronomique. |
| *Vienna* - - - - | Die Kaiserliche Akademie der Wissenschaften. |
| *Vienna* - - - - | Die Geographische Gesellschaft. |

# TREASURER'S ACCOUNT, 1884-85.

**Dr.** *The* LITERARY AND PHILOSOPHICAL SOCIETY, *in Account with* MALCOLM GUTHRIE, *Treasurer.* **Cr.**

| 1884–85. | £ | s. | d. |
|---|---|---|---|
| To Cash paid Royal Institution for Rent | 20 | 0 | 0 |
| „ „ D. Marples & Co. Limited (Printing and Binding Volume XXXVIII) | 116 | 10 | 0 |
| „ „ D. Marples & Co. Limited, Stationery, Extra Copies, &c. | 22 | 6 | 0 |
| „ „ Doling (Refreshments) | 27 | 9 | 6 |
| „ „ S. Burke (Attendance) | 1 | 12 | 6 |
| „ „ Making and Fixing Library Shelves | 0 | 6 | 3 |
| „ „ "Year Book of Science" | 0 | 6 | 0 |
| „ „ Treasurer's Expenses | 0 | 17 | 6 |
| „ „ Secretary's Expenses | 17 | 10 | 6 |
| „ „ „ Editorial Fee | 10 | 10 | 0 |
| „ „ Librarian's Expenses | 3 | 19 | 7 |
| „ „ Tinling & Co. (Printing Circulars) | 9 | 13 | 0 |
| „ „ Balance in Treasurer's hands | 29 | 1 | 2 |
| | £260 | 2 | 0 |

| 1884–85. | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| Balance forward | | | | 44 | 4 | 4 |
| By Cash from Subscriptions:— | | | | | | |
| 9 Entrance Fees, at 10s. 6d. | £4 | 14 | 6 | | | |
| 191½ Annual Subscriptions, at 21s. | 201 | 1 | 6 | | | |
| 3 Arrears, at 21s. | 3 | 3 | 0 | | | |
| | | | | 208 | 19 | 0 |
| Interest on Dock Bond | | | | 6 | 11 | 2 |
| Sale of Proceedings | | | | 0 | 7 | 6 |
| | | | | £260 | 2 | 0 |
| Balance forward | £29 | 1 | 2 | | | |
| Dock Bond | 150 | 0 | 0 | | | |
| | | | | 179 | 1 | 2 |

Examined and found correct,

(*Signed*), ISAAC ROBERTS,

EDWARD DAVIES.

# PROCEEDINGS

OF THE

# LIVERPOOL

# LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING.—SEVENTY-FIFTH SESSION.

ROYAL INSTITUTION, October 5th, 1885.

RICHARD STEEL, PRESIDENT, in the Chair.

The Minutes of the last Meeting of the previous Session were read and confirmed.

The Honorary Secretary read the following

## REPORT.

The Council of the Literary and Philosophical Society, in making their Report for the Seventy-fourth Session, once more desire to record their sense of the good work accomplished by the members from year to year.

Papers of great value have been contributed to the *Proceedings* during the Session now passed. The attendance at the Meetings has been encouraging, and discussion has been well maintained by those present.

The finances of the Society are in a satisfactory condition, and the Treasurer's Accounts shew a balance in hand,

although the pecuniary income of the Society has diminished in consequence of the reduction in the number of ordinary members.

At the commencement of the Session, there were 247 ordinary members on the roll. Of these, the Society has lost six by death, thirty-five by removal from the neighbourhood and resignation, and eleven whose membership has ceased under Law 2.

Three of the deceased members, namely, Mr. John Lear, Mr. Henry Greenwood, and Mr. T. C. Archer, had been connected with the Society for the respective periods of 41, 32, and 32 years.

Mr. Archer was a very active member, and a frequent contributor on subjects of natural history during the time that he was resident in Liverpool, being then Lecturer on Botany in Queen's College, attached to the Liverpool Institute. He was also one of the Vice-Presidents of the Society for several years.

Among those who have resigned in consequence of their removal from Liverpool, the Council desire to note the names of Mr. Alfred E. Fletcher* and the Rev. Dr. Stern. The hearty congratulations of the Society upon the well deserved promotion of these gentlemen to higher and more important spheres of usefulness have already been unanimously passed, but the Council feel that it is further due to their late colleagues to express in this Report their sense of the valuable services which the Society received from them, as members of the Council and contributors to the volumes of *Proceedings*.

The Council have also to record the death of a much esteemed honorary member, Mr. T. J. Hutchinson, late British Consul at Callao, in Peru. Mr. Hutchinson was a

* Mr. Fletcher was, until recently, Inspector of Alkali Works for the Western District. He is now the Chief Inspector.

member of the medical profession, and received his professional education at the University of Dublin. He then came to Liverpool, and engaged as surgeon with vessels trading to Old Calabar. His experiences on the West Coast of Africa enabled him to study the causes and treatment of African fever, and the knowledge he thus gained was turned to practical use in the "Pleiad" Exploring Expedition up the Niger-Ishadda, or Benüe river, in 1854–55. In this expedition he acted as Senior Medical Officer. A paper on the Filatahs, who inhabit that region, was read by him before the Society immediately on his return to Liverpool. After this he became British Consul at Fernando Po, and again favoured the Society with an account of the aborigines of that island. From that time, until his retirement from active life, he continued to furnish the Society with valuable information concerning the countries wherein he was resident from time to time. In 1861 he was transferred to the consulship at Rosario, in the Argentine Republic, and subsequently contributed papers on the Parana Indians, on the Paraguayan War, and on the Meat Supply which might be sent to England from the extensive plains which are fertilized by the waters of the Parana and Paraguay. Removing after this to Callao, Mr. Consul Hutchinson again imparted to the Society the results of his explorations among the antiquities which still exist and bear evidence of the ancient civilisation of Peru. In the midst of this active work for the Society, he was, at the same time, contributing other papers to many of the learned societies in London, and writing works of travel, copies of which were regularly presented to the Society's library. It will thus be seen that he was eminently entitled to the honorary membership which the Society conferred upon him in 1857, and that his work is worthy of being specially recorded in this Report.

Through the changes now noticed, and the election of ten new ordinary members during the Session, the Society now consists of 205 ordinary members, 36 honorary members, 22 corresponding members, and 12 associates.

The condition of the Library has been under the consideration of the Council, with the view of rendering it more useful to the members. Owing partly to the want of accommodation, the numerous publications received by the Society have not been classed so as to be readily accessible. Measures are now being taken to remove this defect.

The Council note with satisfaction the continued success of the Associated Soirées. Eight of these interesting re-unions have now been held, and they bid fair to become a permanent institution in Liverpool.

The Honorary Treasurer presented the Annual Statement of Income and Expenditure, which was approved of and passed.

The following Office-bearers were then duly elected:—Vice-Presidents—Isaac Roberts, F.G.S., F.R.A.S., J. Sibley Hicks, F.R.C.S., F.L.S., Professor Herdman, D.Sc.; Honorary Treasurer—Malcolm Guthrie; Honorary Secretary — James Birchall; Honorary Librarian — Robert F. Green; Members of Council—Principal Rendall, M.A., Henry Longuet Higgins, Josiah Marples, Chas. J. English, Wm. A. Unwin, B. L. Benas, Rev. R. E. Long, B.A., John W. Hayward, M.D., Richard J. Lloyd, M.A., Frederick W. Edwards, R. J. Harvey Gibson, M.A., F.R.S.E., Rev. J. Polack, B.A., John Lovell, R. McLintock.

The Associates of the Society were re-elected.

The President elect then delivered the Opening Address.*

* See page 1.

## FIRST ORDINARY MEETING.

Royal Institution, October 19th, 1885.

ISAAC ROBERTS, F.G.S., Vice-President, in the Chair.

Rev. Arthur Whatham, M.A., was elected an ordinary member.

Professor Herdman gave a general account of the First Year's Work of the Liverpool Marine Biology Committee. The reports presented by this Committee form an Appendix to this Volume.

Mr. F. Archer, B.A., exhibited a series of Shells collected above the Third Cataract of the Nile, about eight miles north of Korti, by Brigadier-Surgeon S. Archer, corresponding member of the Society.

Mr. T. J. Moore gave an account of his recent visit to the chief Museums in Holland and Brussels.

Rev. H. H. Higgins exhibited the following objects:—A small series of living curiosities in Botany, kindly supplied by Mr. Richardson, the curator of the Liverpool Botanic Gardens.

Also, a group representing various Siberian fruits and leaves, cut from the precious stones of the region, by the families of the Exiles; purchased for the Liverpool Museum from Mr. R. Damon, of Weymouth.

## SECOND ORDINARY MEETING.

Royal Institution, November 2nd, 1885.

RICHARD STEEL, Ex-President, in the Chair.

Professor Conway, Dr. Brannigan, Mr. W. Oulton, and Rev. Gerhardt Krusman were elected ordinary members.

Mr. R. J. Harvey Gibson, M.A., read a short "Note on an abnormality in the Ovary of the Liliaceæ," where, in place of the usual trilocular ovary, only two chambers were formed. He pointed out, however, that by making a series of sections transversely from the base of the ovary towards the peduncle, the missing loculus was found to be represented by one fibrovascular bundle, viz., the one corresponding to the midrib of the missing carpellary leaf. He argued from this that it might be possible to trace relationships between different natural orders by studying the distribution of fibrovascular bundles by a series of transverse sections through the peduncle and base of the flower.

Mr. R. C. Johnson, F.R.A.S., contributed the following

## NOTE ON THE NEW STAR IN THE NEBULA OF ANDROMEDA.

Everyone who has searched the heavens for the purpose of discovering comets knows the nebula in Andromeda as the only one which is visible on ordinary nights to the unaided eye, and every possessor of a common telescope has often directed his gaze to this inscrutable object; so that since the 3rd of last September, when the sudden appearance of a bright star right in its midst was announced, it has been the subject of almost continuous telescopic observation.

The great Nebula in Andromeda, though merely a faint

speck to the eye, is seen, when examined with powerful telescopes, to extend over a space in the heavens eight or ten times the size of the moon. It is irregular in shape, and completely environs two brightish nebulæ which are near to it, and there are about 1,500 small stars in it or before it. Such an object has naturally commanded the attention of observers, and its most conspicuous feature (if the expression may be allowed) has been the entire absence of such a central condensation as would admit of even the suspicion of a stellar nucleus.

The interest attaching to the discovery of this new star has arisen not from the fact of its being a variable or temporary star, but from the connection, real or apparent, which it has with this wonderful nebula.

That the connection is real is already generally accepted.

When examined with high powers, it was at first suspected that the star shewed a disc of a planetary nature, but further observation has tended to prove its stellar character. The star appears to be deeply involved in the nebulosity, and it is probably for this reason that it is not always sharply defined.

Micrometrical measures confirm the reality of its connection with the nebula; for if it had been an asteroid, a comet, or an extra-Neptunian planet, it would have moved long ere this, whereas it has so far, relatively to the nebula, remained stationary.

Photography confirms ocular observation in almost every respect—where a difference exists it is in regard to the nebula proper and not to the star.

Our vice-president, Mr. Isaac Roberts, with a 20-inch reflector, has secured a most successful series of negatives (*vide* his address to the Liverpool Astronomical Society, 13th Oct.), all of which, with varying lengths of exposures, readily show the star, and all of which likewise testify to the

singularly non-actinic character of the nebula. Mr. A. A. Common, with a 36-inch mirror, confirms this peculiarity.

The astronomical world was startled by the suddenness of the apparition, but we now know that the star rapidly but gradually rose to the sixth magnitude, which it attained as its maximum about the 3rd of September, for from a large number of communications to various scientific journals and societies, it seems that no star was perceived by several observers of the nebula between the 13th and 18th August, while on the 19th (the following day), Mr. Isaac Ward, of Belfast (who has singularly acute vision), saw the star; it was also seen independently on the 22nd August as "a little star" by the Baroness de Podmaniczky, of Hungary.

We have here, then, the usual phenomena exhibited by temporary stars—a rapid increase of magnitude followed by (what we are now witnessing) a slow decline, which may possibly continue to absolute extinction.

From the Spectroscope but little has yet been gathered, for several very good reasons—firstly, the faintness of the star; secondly, the brightness of the nebula; and thirdly, the ill-defined nature of the lines in its spectrum. Dr. Huggins, with his fine instruments and long practice, makes out three or four faint bright lines superimposed upon a faint continuous spectrum, while many other observers have been unable to discriminate between the spectrum of the star and that of the surrounding nebula. However, the character of the spectrum decidedly indicates real connection with the nebula.

The resemblance in this respect to the temporary stars, *Nova Cygni* and *T. Coronæ*, is a point of the utmost importance, and favours the theory that the flaring up of these objects is due to some change in a gaseous atmosphere surrounding them.

The remoteness of the chance of such a connection being

only apparent, according to the doctrine of probabilities, has been ably discussed by Mr. Proctor, so that I think we may reasonably conclude that the new star is really in the nebula of Andromeda.

Mr. E. W. Maunder has pointed out the fact that these temporary stars cannot be suns such as ours, because if our sun were to receive an accession of a thousandfold his present heat and brightness it would be impossible for its former scale of radiation energy to be resumed in the space of a few weeks or months; so that it would appear that these bodies are relatively minute, though till some appreciable parallax has been obtained for one of them we cannot venture to guess their actual size. It is to be hoped that this star will not fade away until the solution of this important problem has been arrived at. It would also solve the much more interesting problem as to the distance and dimensions of the Queen of the Nebulæ.

Mr. Josiah Marples read a Paper on "A Noble Family of the Middle Ages." *

## THIRD ORDINARY MEETING.

Royal Institution, November 16th, 1885.

Dr. CARTER, President, in the Chair.

Messrs. Jas. Veitch, M.A., W. B. Halhed, and G. F. Moore were elected ordinary members.

The death of Dr. W. B. Carpenter, honorary member, was notified to the meeting. Observations on his life and work were made by Rev. H. H. Higgins and Sir J. A. Picton.

* See page 37.

Mr. J. L. Palmer reported some observations he had been making on the Sleep of Fishes and their Powers of Memory.

Mr. T. J. Moore read a "Report on a successful importation of living Soles to the United States." *

Professor Oliver J. Lodge read a Paper on "Fuel and Smoke."

## FOURTH ORDINARY MEETING.

Royal Institution, November 30th, 1885.

Dr. CARTER, President, in the Chair.

Professor Herdman exhibited and described some large Embryological Models which he had had made of clay, painted and varnished in the Zoological Laboratory of University College. They illustrated stages in the formation of the typical Gastrula and Planula, and were found to be of use in explaining to a class some of the more important early embryological processes, such as "invagination" and "delamination."

Mr. T. J. Foard read a Paper on the "Development of Personal Liberty in England from the Petition of Right to the Present Time."

## FIFTH ORDINARY MEETING.

Royal Institution, December 14th, 1885.

Dr. CARTER, President, in the Chair.

Mr. Walter Lewin read a Paper on "John Brown of Harper's Ferry." †

* See page 185. † See page 163.

## SIXTH ORDINARY MEETING.

Royal Institution, January 11th, 1886.

Dr. CARTER, President, in the Chair.

Mr. R. J. Harvey Gibson, M.A., read a Paper on "The Forms of Flowers."

The Rev. H. H. Higgins exhibited six cases of Insects injurious to Agriculture, with their life history illustrated and described. They form part of a series lately purchased for the Free Public Museum from Mr. S. L. Moseley, of Huddersfield, by whom they were mounted and prepared.

The specimens exhibited consisted of the following:—

Turnip Fly, or Flea Beetle, *Phyllotreta nemorum.*

Vine Beetle, *Otiorhynchus sulcatus.*

Turnip and Cabbage Gall Weevil, *Centorhynchus sulcicollis*, Stephens.

Goat Moth, *Cossus ligniperda*, Fab.

American Blight, *Schizoneura lanigera*, Hausm.

Cabbage Aphis, *Aphis Brassicæ*, Linn.

## SEVENTH ORDINARY MEETING.

Royal Institution, January 25th, 1886.

Dr. CARTER, President, in the Chair.

Messrs. W. J. Harries and G. Beckett were elected ordinary members.

Professor Herdman explained, with illustrations, the process known in Biology as "Phylogenetic shifting."

Rev. H. H. Higgins read a letter from Mr. E. Blackford,

New York (Jan. 18th), announcing the successful importation of a second lot of Living Soles.

Rev. S. Fletcher Williams read a Paper on "Socrates, his Method and his Teaching in relation to Modern Thought."*

## EIGHTH ORDINARY MEETING.

Royal Institution, February 8th, 1886.

Dr. CARTER, President, in the Chair.

Mr. W. R. Melly was elected an ordinary member.

Mr. B. L. Benas read a short Paper on "Two Curious Papyri in the Khedivial Museum at Boulak." †

Rev. H. H. Higgins read a Paper on "Local Pioneers in Marine Biology." ‡

## NINTH ORDINARY MEETING.

Royal Institution, February 22nd, 1886.

Dr. CARTER, President, in the Chair.

Mr. Luke Currie was elected an ordinary member.

Rev. H. H. Higgins exhibited a beautiful Model, in glass, of Venus's Flower Basket.

Mr. R. F. Green read a Paper on "Herbert Spencer's *Ecclesiastical Institutions*." §

* See page 65. † See page 89. ‡ See *Appendix*, page 16.
§ See page 197.

## TENTH ORDINARY MEETING.

Royal Institution, March 8th, 1886.

Dr. CARTER, President, in the Chair.

Mr. R. D. Darbishire was elected an ordinary member.

Mr. F. W. Edwards exhibited specimens of the principal foreign merchantable woods imported into Liverpool. The specimens were collected for the purpose of being exhibited in the approaching International Exhibition, and were to be arranged so as to show their natural condition, and their use for veneering and figured ornamentation. Among the most notable examples were Californian Redwood or Sequoia, Jamaica Quassia wood, South American Partridge wood, Granadian and African Mahogany, Para Cardinal wood, Honduras Ziricote wood, Siam Sapan wood, South American Purple-heart and Tulip wood, and African Cam wood and Bur wood.

Rev. H. H. Higgins exhibited a collection of twenty-four species of Hydroid Zoophytes, presented to the Museum by Miss Gatty, Corresponding Member of the Society.

The species are chiefly from the Southern Hemisphere, and are mostly new, having been described by Dr. Allman.

Mr. McLintock read a Paper on "Hans Sachs."*

## ELEVENTH ORDINARY MEETING.

Royal Institution, March 22nd, 1886.

Dr. CARTER, President, in the Chair.

Rev. J. S. Jones read a Paper on "Poetry as an Education, with special reference to Browning."

* See page 97.

## TWELFTH ORDINARY MEETING.

ROYAL INSTITUTION, April 5th, 1886.

DR. CARTER, PRESIDENT, in the Chair.

Mr. R. C. JOHNSON read a "Note on the Comets of Fabry and Barnard now visible."

Dr. SHEARER exhibited the *Clivea nobilis* in flower; the Fruit-capsules and Seeds of the *Theobroma Cacao* and the *Ascidia;* and Inflorescence and Capsules of the *Nepenthes Rafflesiana*—the pitcher-plant of the East Indies.

The latter were grown in the hot-houses of the Liverpool Botanic Gardens, and kindly supplied by Mr. Richardson, the Curator. They do him credit, for this plant rarely thrives well in conservatories.

The pitchers are now recognised, and were shewn to be a development of a special gland which in its early stage is of a triangular form, indented above, and forming the apex or extreme tip of the prolonged midrib of the leaf. In course of time the indentation deepens, and the walls bulge out, until a secretory vessel or amphora is formed, with a regular operculum or lid. This is said to open and shut hinge-wise, and nothing can be more beautiful than the general outline, or the braided margin, of the flask, which seems close-stitched like a button-hole with silk thread. The pitchers of the upper leaves are long, narrow, and horn-like, while those of the lower leaves are of a wide pattern, and much more elegant, of a greenish ground-tint, spotted with crimson and purple, like a lapwing's eggs. Since the fluid contains binoxalate of potash, it is evidently *a secretion*, and no mere "rain-catch," and it serves to facilitate the solution of the bodies of the unfortunate insects which drop into the pitchers, and thus form a source of nourishment to

the plant. The Malay Archipelago is still the wonder-land of the naturalist. It is the country of the Mangosteen and the Durian, the Rattan, the Calamus, and the Nepenthes; it is the native seat of the Lemur, the Bird of Paradise, and the Orang-utan. The pitcher-plant is one of Darwin's carnivora. Wallace says that, in his travels over the arid hills of Java and Borneo, he has frequently slaked his thirst with the somewhat tepid and slightly acidulous fluid secreted by the pitcher-plant. Every mountain-top abounds with these wonderful pitcher-plants, running along the ground or climbing over shrubs and stunted trees, their elegant pitchers hanging in every direction. There was nothing repulsive or uninviting to the thirsty traveller in the presence in the liquor of the bodies of innumerable insects in all stages of dissolution, and they were easily strained off. The finest plants were obtained from the summit of Kíni-balon, the highest mountain in Borneo, the Nepenthes Rajah, one of the broad sort, bearing pitchers which will hold a couple of quarts of liquor.

Mr. B. L. Benas exhibited a large Photographic Panorama of Constantinople.

Dr. Nevins read a Paper on "Recent Locust Plagues in Cyprus and North America." *

Mr. Unwin called attention to some experiments which had been made at Oporto, by Mr. Albert C. F. Morgan, on the breeding and development of winged *Phylloxeras*, which are said to be very rare in Portugal. The experiments pointed to the conclusion that the winged form of these destructive insects is due to insufficient nourishment, since he found that the *Phylloxeras*, provided with abundance of vine roots, prematurely reached puberty, and gave life to other beings before reaching the winged state, while those

* See page 123.

which were scantily supplied with food attained this higher form at an earlier stage, and were thus enabled to emigrate to a distance in search of nourishment. The experiments are reported in the *Jornal de Horticultura Practica*, vol. xvii, Oporto, Janeiro, 1886.

## THIRTEENTH ORDINARY MEETING.

Royal Institution, April 19th, 1886.

Dr. CARTER, President, in the Chair.

Rev. H. H. Higgins read the following Note on

### FOSSIL INSECTS FROM THE COAL MEASURES, RAVENHEAD, ST. HELENS, 1870.

The larger and finer example of the two insects now exhibited, was collected at the same time and place with the other fossils in the Ravenhead Collection, but has only within the last few months come into my possession.

Early in May, 1870, my attention was called to some interesting geological features exhibited by the banks of a railway cutting, then being commenced in the immediate neighbourhood of Ravenhead, St. Helens, about one and a half miles from the house in which I reside. Two almost contiguous beds of coal, known as the higher and lower Ravenhead coals, had been exposed, and colliers were obtaining in the open daylight a limited supply of serviceable fuel. Armed with suitable instruments for detaching fragments of the grey shales forming the roof and the floor of the coal seams, some of the younger members of my family with myself, paid frequent visits to the spot, at first with very moderate success; but weekly, and almost daily, the specimens collected became more abundant and of greater interest,

till, as the railway operations proceeded, it became manifest that by diligence and perseverance the cutting might be made to yield a valuable contribution to the vegetable Palæontology of our district.

The geological position of the plant remains is very definitely ascertained. It is the upper part of the middle coal measures, overlapping at each end the interval between the coal seams, known as the Ravenhead and Pigeon-house coals of the St. Helens coal field. In the *Geological Memoirs* this interval is estimated at 271 feet perpendicular thickness, consisting of grey, white, and ferruginous sandstones. Bluish shales occur at each end in the vicinity of the coal-beds. The line of rails crosses the general dip of the strata obliquely, and thus gives a section of the interval between the two coal-beds, on a magnified scale of about 4½ diameters.

My explorations at the cutting were continued for about ten months at the rate of three visits per week. The results may be seen in the Liverpool Museum. In addition to the assistance afforded by a considerable number of the excavators, three or four boys from the Ravenhead National Schools were induced by me to spend their leisure time in the cutting, and soon became zealous collectors, especially of ironstone nodules, which they learned to split very cleverly.

From one of these boys, two young geologists from Rugby, on a visit to the cutting, obtained the larger of the two specimens now exhibited. It was a singular coincidence which thus separated from the collection the finest and most valuable fossil obtained during the whole exploration. For some years my overtures towards its acquisition by a liberal exchange or purchase were declined, and it was my only consolation to feel that its possessors must highly appreciate its interest and value.

In June (1885) last, Mr. T. P. G. Smith, formerly of Smith & Rawdon, of Liverpool, the father of one of the

young geologists, who had previously forwarded a beautiful woodcut of the fossil, kindly made me a present of the specimen which is now with the Ravenhead Collection in the Museum.

## GEOLOGICAL COLLECTION OF THE LATE MAJOR THOS. AUSTIN, F.G.S.

Rev. H. H. Higgins reported that the above collection had been recently purchased for the Liverpool Museum, and had been carefully packed at Bristol, and removed to the Museum by Mr. Moore, the curator. Its principal features consisted of the well-known collection of Carboniferous Crinoids, to the collection and study of which Major Austin devoted so many years of his life; and of his collection of Fossils from the Millstone Grit discovered by him in Britain. Major Austin commenced, but, from insufficient encouragement, did not complete his work, entitled, *A Monograph on Recent and Fossil Crinoidea, with figures and descriptions.* Of this work, in quarto, only 128 pages, 16 plates, and frontispiece were published. The unpublished drawings and text remain the property of his family; but the specimens figured and described therein are now permanently placed in the Liverpool Museum.

Selections from the collection were exhibited to the Meeting by Mr. Higgins, and explained by Mr. F. P. Marrat, who is busily engaged in carefully working out the specimens, especially those referred to in the MS. Catalogue by Major Austin.

Rev. H. H. Higgins also exhibited a series of coloured glass models, illustrating the development of *Aurelia aureta*, and models of *Tubularia indivisa*, part of a series of forty models by Blaschka, of Dresden, recently purchased for the Museum, per Mr. R. Damon, of Weymouth.

Dr. J. Sibley Hicks described, at considerable length, the life history of the forms exhibited.

Mr. T. J. Moore exhibited, from the Liverpool Museum, several pictorial groups of Birds, recently prepared from the Derby Collection, by Mr. Henry Reynolds, Museum Taxidermist, including several groups of the *Pettidæ*, or Ant Thrushes, and two groups of the genus *Sturnella*, or Meadow Starlings, from North and South America.

## *OSTEOCELLA SEPTENTRIONALIS.*

Mr. T. J. Moore exhibited four specimens of this rare genus of Sea Pens, measuring respectively seven feet, four feet (two specimens), and three feet six inches in length, lately received, with notes and other specimens, from Capt. Griffith S. Jones, barque *Hermine*, Associate Member of the Society. Mr. Moore read Capt. Jones's observations thereon as follows:—

"Victoria, British Columbia, Sept. 10, 1885.

"*Osteocella septentrionalis.*

"These were obtained in Burrard Inlet, B.C., in a depth of from ten to twenty fathoms. The mode of obtaining them was thus: Some one hundred and fifty fish-hooks were made fast to a long line, one end of which was anchored in about ten fathoms; then a boat with five hands took a circular sweep, leaving sufficient line to reach the bottom. Returning to the place they started from, the line was hauled in, when the *Osteocella* were found attached to the hooks. Generally a number of Dog-fish are caught at the same time. The fishermen, mostly Indians, do not know if they swim or are fast to the ground. However, it is quite evident that they are fast to the bottom. These in the tube had from two to four inches of dark mud and small stones still attached to them. The bend at the lower part serves as an anchor to keep them in their places.

"I spoke to an Italian fisherman—an expert diver—who had seen them at the bottom, undisturbed and 'in bloom,' as he called it. He believed that they were seaweed, and he had for a proof that he saw pretty little flowers on them. No wonder that the little polypes deceived him.

"I had no time to go and attend to this fishing, or else I would have endeavoured to preserve one with its polypes protruding. When first caught, they are much softer than after they have been some time in alcohol. Some of the people make walking-sticks out of the stem. They also make very pretty ladies' riding-whips. From hearsay, I may add that they grow in some places to the length of ten or twelve feet. They are found in several of the Inlets. In Howe Sound, they have been fished from a depth of one hundred fathoms."

Mr. Moore also read the following extract from the Note Book of Capt. Griffith Jones:—

"Abundance and Variety of Marine Life at St. Juan de Fuca.

"Mouth of the Strait of St. Juan de Fuca, British Columbia, August, 1885.

"Dredgings in twenty fathoms. The mouth of this Strait is teeming with life of every kind that is to be found in the sea: Whales, various species of Dolphins, Seals, Porpoises, Medusæ, Salpæ, Crangonoids, Albatrosses, Divers, Gulls; numerous kinds of Seaweed; Salmon, and other fish. Having approached the Strait in a fog, these lines gave us the first warning that land was near. The noise from the incessant clatter of the birds, and blowing of the whales, inspired a new life into us after being so long at sea."

# PAPERS READ DURING SESSION.

# MODERN SCIENTIFIC THEORIES OF MAN: FACTS IN INDIVIDUAL AND SOCIAL HUMAN LIFE—A CONTRAST.

By WILLIAM CARTER, LL.B., M.D.,

B.SC. UNIV. LOND., F.R.C.P. LOND., PRESIDENT.

"What am I, and what is my relation to other beings around me?" are questions which every man given to reflection will probably often ask himself.

To the question, "What am I?" there are two distinct, if not opposite replies. Much of what is recognised as modern science has given one; the general voice of humanity, past and present, another. The answer given by science is not always final, for some of her disciples, rendered modest by the consciousness that she can necessarily have only to do with the phenomenal, confess that there is room outside of her methods for a revelation of realities upon which she can throw no light. Others, however, and those probably the more immediately, if not the more permanently, influential, lay down principles which exclude the possibility of any higher revelation than that which she can unfold.

It is my object in this paper to state these principles, and certain conclusions of the highest interest to humanity, which are claimed as resulting from them; to contrast them with facts of consciousness of which every man, learned or unlearned, is cognisant; and then to leave it to the judgment of each to determine on which side the greater claim to authority lies.

The general verdict of mankind concerning themselves is that they consist of self-conscious reasoning beings, placed in the midst of external things which, though different in

nature from themselves, are nevertheless real things of which they are able to take a real cognisance; that they are conscious of being able to choose between alternatives of conduct, of which one may be right and another wrong, and that if, yielding to their inclination, they should do that which is wrong, it is not because they have not the power effectually to resist the inclination and act differently from what they do—or, in other words, that they are free agents, and hence morally responsible for their deeds; and, lastly, that they are not only moral, but religious beings, impelled by a primary sentiment of veneration to go out beyond themselves in reverent worship of some transcendently greater personality whose commands are regarded by them as authoritative.

Yet we are plainly told that all this is a delusion. Man has not the power of choice. Neither individually nor socially has he any freedom of will; he may think that he has, but that is only because he is not a philosopher. If he were one, he would convince himself by many methods of his error. If a statist he would see the necessity of diminishing the errors arising out of too contracted a view, and, no longer looking within for fancied springs of action, he would collect as large a body of statistics relating to as large a number of people as possible—*i.e.*, in this country the Registrar General's returns since the establishment of civil registration; the reports of hospitals, prisons, and workhouses; and in other countries statistics of a corresponding character—and carefully studying these, he would find that the same proportion of births, marriages, and deaths; of suicides and murders; of lesser crimes and poverty, recurred with such dreary uniformity, year after year, as at length to force the conviction upon him that that which, from a mere consideration of what was going on in the very limited spot of earth on which he happened to be dwelling, and from an

interchange of ideas with ordinary men like himself, he had imagined to be the result of the free play of social forces, controllable by those who manifested them, was, after all, nothing but the necessary outcome of the working of a huge machine, into the structure of which he entered, but the action of which he was quite powerless to alter. So very constant did the results of such statistical studies appear to those philosophers who were endowed with the necessary ability and patience to cast up the great account, that it was equally clear to them that, if the process could have been extended, there would be found a similarly uniform recurrence of all those other acts which do not, and cannot, find their expression in statistical tables—that every year would witness the same proportion of those little nameless deeds of what, in our unphilosophical language, we call goodness, that serve to sweeten human life, and of those other and opposite deeds which embitter it; that once in a certain number of years a man would of necessity appear exhibiting the self-denying heroism of a General Gordon; and that, on the other hand, the exact number of times that the people of Great Britain and Ireland would be guilty of deception or petty acts of meanness, could be so accurately forecast as to make it plain that the loftiest as well as the lowliest human acts were alike independent of will. Or such a broad and philosophical view of statistics would, in the words of one of the philosophers themselves, "go to show indeed that the moral as well as the other actions of man are the product, not of their volition, but of their antecedents."

Are there any facts in modern social life that contrast with the view of collective humanity, thus set forth by Mr. Buckle as the outcome of his statistical studies? I believe that there are many, though want of space will only allow me to state one by way of illustration. Take the rate of mortality in England and Wales. Mr. Buckle's proposition

was that the same proportion of deaths to population occurred with such undeviating regularity, year after year, as to prove the powerlessness of man by any act of his will to alter the conditions causing it. But this conclusion was premature, for it could not be known whether he had or had not the power effectually to interfere until the fact to be dealt with was established, and the fact could not be established except by a large body of statistics extending over a large number of years; and even when established to the satisfaction of the philosopher, could not be known by those with whom lay the power of action until it had been iterated and re-iterated many times and in many ways. So soon however as this had been done, and as it appeared to be clearly proved that spite of improvements here and improvements there, which men who did not extend their view beyond their own neighbourhood thought were fair indications of improvement everywhere, the rate of national mortality was maintained at a singularly uniform level, the national will, expressing itself by means of a general Act of Parliament, proved at once that the presumed powerlessness did not exist. The death rate had continued for many decades at 22·5 per 1000. But no sooner was the Public Health Act of 1872 passed, than it began to diminish, and it has been steadily and progressively diminishing ever since, falling in 1881 to 18·9; so that by this single free intervention of the national will, which by Mr Buckle's hypothesis has no existence, very many thousands of lives have been saved. And the question comes with startling force "Can the beings who are thus capable of intelligently surveying the order of events, of recognising the forces which influence it, and of consciously interfering to direct and alter these forces, be the mere blind outcome of what they thus control?"

But from the analysis of the social and individual man's doings and sufferings, science has proceeded to the analysis

of man himself, with results that are by no means flattering to his pride. This analysis has been of various kinds, Chemical, Biological, Physiological, and Physical.

Chemistry has long ago determined to a nicety the exact quantity of the several elementary substances that enter into the composition of an average human adult, and any one who is curious to know what he himself is, from a merely chemical point of view, can have his curiosity gratified by a visit to the South Kensington Museum. In one compartment of that building the result of the analysis is, or used to be, placed before him with great plainness. A few grains of iron and magnesium, a rather larger quantity of potassium, sodium, calcium, and a few other metals, a little sulphur and phosphorus, a large lump of carbon, enough of silica and of a fluoride to give an idea of the small amounts of silicon and fluorine present, and statements of the cubic space which the oxygen, hydrogen, and nitrogen in the human body would occupy if they could be set free, and the whole story of man's composition, so far as modern chemistry can tell it after she has carried her analysis back to its farthest possible limit, is told. The specimen analysed may have been a very great saint or a very great sinner, a genius or a blockhead, but these are facts of which chemistry, as such, takes no account. . She cannot discover any elements representing virtue or vice, or any other moral or intellectual quality, so she discreetly says nothing about them, but confines herself to telling us what she can discover.

The same judicious reserve has not been exercised by those who have employed other than chemical methods of analysis. If we turn to the biologist, the physiological microscopist, and the physicist, much that chemistry has left obscure is said to be by them cleared up.

Before presenting the presumed results of their investigations, it is well to recall for a moment some of those

principles—only established within the last few years, though, doubtless, the human mind had been long silently preparing for their reception—which have revolutionised man's conceptions of nature. Evolution, the correlation of the physical forces, the conservation of energy, and heredity, have but to be mentioned to call up before the mind the vastness of the change which those conceptions have undergone. No sooner had those principles been established than it was felt that any merely narrow application of them was impossible, and with the exception of the last they were applied to the whole field of nature, inorganic and organic, non-sentient and sentient, non-human and human alike. Of the truth of all of them no one probably seriously doubts. The only question is concerning the extent of their applicability and their possible harmony with some higher and more all-embracing principle than themselves.

Turning to biology we find that one of the greatest of its recent generalisations consists in the presumed establishment of a universally diffused physical basis, which is supposed to underlie the manifestation of all vital phenomena. We are told by Professor Allman, in his Sheffield address, that "all recent research has been bringing out, in a more and more decisive manner, the fact that there is no dualism in life, that the life of the plant and the life of the animal are, *like their protoplasm, in all essential respects identical,*" and he then gives us the most generalised statement of what living matter is, or in other words an account of the most recent researches into the nature and phenomena of that which Von Mohl, in 1846, was, I believe, the first to term protoplasm, a word that has been and is in almost eveybody's mouth ever since. But do we sufficiently understand what the substance is, for which this word stands, to warrant us in saying, not in a conjectural way, as of something possible or even probable, but with dogmatism,

as of something scientifically proved beyond the reach of legitimate doubt, that that which is found in plants is in all essential respects identical with that which is found in animals; or that that which is found in one animal, or one part of an animal, is in all respects identical with that which is found in another animal or part? However presumptuous it may appear, I cannot help saying that the evidence for the universal diffusion through the animal and vegetable kingdoms of any such practically identical substance seems to me singularly weak and unsatisfactory. To read the address of the distinguished man to whom I have referred, one would be tempted at first to think that the great problem of life was at length well nigh solved. For we are told that "it"—protoplasm—"is a tangible, visible reality which the chemist may analyse in his laboratory." And again, "that wherever there is life, from its lowest to its highest manifestations, there is protoplasm; wherever there is protoplasm, there too is life." But just when we are fairly expecting to be told that this substance so universally diffused, so easily obtainable, which the chemist *may* analyse, *has been* analysed, and its exact composition determined, and then that it has been synthesised and, as a consequence, life produced, we read that "the chemical composition is very complex and has not been exactly determined." Exactly determined! Has it been anything like determined? Is there the slightest approach to agreement concerning its precise composition among those who have most closely investigated it? If, anxious for something really definite as to its nature, something on which the mind can rest, we turn to another authority, this is what we are told, "Protoplasm consists of a combination of *apparently* different albuminous substances, with water and small quantities of incombustible materials (ashes). In *most* cases it also contains . . . considerable quantities of other organic compounds, belonging *probably* to

the series of carbo-hydrates and fats. These admixtures are distributed through its mass in an invisible form, but it *not unfrequently* includes visible granular formations of starch and fats, which, at a subsequent period, *may* either entirely disappear, or may increase in bulk. *Very commonly* the rapidly increasing protoplasm, in itself colourless and hyaline, is rendered turbid by numerous small granules, consisting, *probably*, of small drops of oil. The protoplasm as it is generally met with ought, therefore, to be considered as true protoplasm with varying admixtures of different formative materials."* Was ever such a definition of a substance, which the chemist may analyse in his laboratory, given before? Has this got the precision, the satisfying exactness of science? We want, and are led to expect, something definite, precise, certain, yet we find so many qualifications in the shape of "apparently," "probably," "in most cases," "not unfrequently," "very commonly," "as it is generally met with" and so on, that instead of certainty we have uncertainty, and instead of clearness, confusion; and there appears to be no guarantee that what we may be examining and calling by the name of protoplasm in this place is, in chemical composition, anything like something which others may be examining and also calling by the same name somewhere else.

And if, despairing of any exact knowledge from the answer thus given, we inquire concerning its other properties, we are not much more satisfied; for we are informed by the same high authority that "the consistence of" this colourless and hyaline "protoplasm varies greatly at different times and under different circumstances. It commonly *appears* as a soft, plastic, tough, inelastic, very extensible mass; in other cases it is more gelatinous, *sometimes* stiff, brittle (in the embryos of seeds before germination): but *very commonly* it

* Sach's "*Botany*," p. 37.

gives outwardly the impression of being a fluid . . . but the protoplasm is nevertheless never a fluid; even the ordinary dough-like mucilaginous or gelatinous conditions of other bodies can only be very superficially compared with it. For the living and life-giving protoplasm is endowed with internal forces, and, as the result of this, with an internal and external variability which is wanting in every other known structure. The capacity which protoplasm has, in consequence of the forces which become manifested in it, of assuming definite external forms and of varying these, as well as its capacity of secreting substances of very different chemical and physical properties according to definite laws is the immediate cause of cell formation and of every process of organic life."* The only unvarying qualities of protoplasm, according to these definitions, are its colourlessness and its hyalinity. Its consistence and form may vary greatly, but in itself it is always colourless and hyaline. It is not a little disappointing then, just as this one property of freedom from colour seemed settled, to be informed in the most positive manner by Mr. Horsley that "protoplasm is gray." †

A few additional quotations may not be amiss in order to shew the uncertainty that really exists concerning the essential nature of any given protoplasm (so-called), and the non-identity, instead of (as Professor Allman states) the identity, that there is between that which is found in one organ or part, and that which is found in another organ or part, even of the same organism, let alone different kinds of organisms. Thus, Dr. Brunton writes: "In all living bodies we find that the protoplasm is of a *more or less* albuminous nature"‡—the more and the less here making all the difference between identity and non-identity. Professor

* Sach's "*Botany*," pp. 37, 38.
† *Nature*, Aug. 20, 1885.
‡ *Pharmacology and Therapeutics*, p. 43.

Huxley speaks of a nerve as being "in its essence nothing but a linear tract of *specially modified* protoplasm"*—the special modification here signifying also a practical non-identity (instead of the reverse) between it and that which has not been specially modified. Dr. Montgomery, who tells us that he has devoted over four years of his life to the "exclusive study" of the "internal nature and functional import of the protoplasmic movements" of monera, which he defines as "minute particles of undifferentiated protoplasm," says that the protrusion of portions of their mass is due to a "loosening of bonds of cohesion which *liquefies* a certain amount of protoplasm," † *i.e.*, brings about a condition which Sachs says never under any circumstances exists. Of course it is easy enough to say that monera are protoplasm, and that nerves and brain are also protoplasm, and no great harm will come of this curious mode of employing language if we only bear in mind that, though called by the same name, the things themselves may be, and probably are, entirely different from each other instead of being practically identical.

What presumably is often meant, and what if it is meant ought to be used, is not the single term protoplasm as though it were a single and practically identical substance of almost uniform and undeviating chemical composition which lay at the root of all vital manifestations however diverse, but the plural, "protoplasms," *i.e.*, the substance (if such there be) special to each kind of organism, and possibly to each organ of each kind of organism, on the presence of which its own vital manifestations are supposed to depend, and which for anything that has been shewn to the contrary, may be fundamentally different from that which is found in any other kind of organism or organ.

* *Science and Culture*, p. 158.
† St. Thomas's Hospital *Reports*, 1878, p. 76.

If, for example, taking the embryos of a highly organised plant and animal, and submitting them to the influence of certain reagents, such as solutions of carmine, iodine, or other colouring principles; or nitric, or sulphuric acid; or caustic, potash, or heat; and getting what appear to be similar reactions from each, the experimenter says, "These are the reactions of protoplasm, and as they are similar in the two cases the substances giving them must be practically identical," surely an objector is entitled to say, "But the most refined of your reactions are after all very coarse, and even if it be granted that no substance, the chemical composition of which has been determined, and which is known not to be what you call protoplasm, gives precisely similar reactions, there is the possibility, beneath the apparently superficial resemblance indicated by the tests, of an almost infinite diversity of composition, and what makes it highly probable that there must be some profound underlying difference which none of your reagents can detect is the extremely significant fact that the embryo or protoplasmic mass in the one case developes into a plant and in the other into an animal, and I take such an obvious difference of result to be a more powerful proof of dissimilarity than the action of your reagents can be of similarity; while to say that the substances *are* really practically identical, but that they are endowed with different internal forces which account for their variability, when such a difference of endowment could never have been deduced from the structure, and would never have been even suspected if the resulting variability had not been seen, is merely to beg the whole question."

If, leaving the biologist, who thus throughout all organised nature sees as the immediate determining cause of every vital manifestation this practically identical substance called protoplasm, we come a little nearer home and consult the physiological microscopists, and especially that

division of the class that has investigated the nervous system, we are presented with results of a very positive character. Protoplasm, when critically scrutinised under their high-power objectives, reveals many a secret withheld from a less observant gaze. Two works especially have been introduced to the world lately with claims of a very exacting kind. They are *The Brain and its Functions*, by M. Luys, Physician to the Hospice de la Salpêtrière, and *Body and Will*, by Dr. Maudsley; and to some of the conclusions arrived at by these gentlemen I must for a few minutes direct your attention.

M. Luys, while remarking that "the controversies of philosophers and metaphysicians which have been taking place from time immemorial have succeeded in arriving but at one thing—the expression in sonorous language of their ignorance more or less complete of the fundamental characters of psychical life," proceeds to shew how very simple these characters are when investigated by men like himself. Psychological processes are then seen to be the simplest and most necessary results of anatomical structure. Having first described a marvellous appearance, which he alone seems to have observed, in the so-called protoplasm of the cerebral cell, he informs us that there are three fundamental properties of nervous tissue, viz., organic phosphorescence, sensibility, and automatism. Everything then becomes transparently clear, as will be admitted when I quote his words. He thus explains the evolution of the phenomena of sensibility as he terms it:—"The simple physical impression produced by the external world is transformed as it becomes incorporated with the organic tissues into nervous vibrations, and these nervous vibrations passing through successive agglomerations of cells undergo the action of the different media through which they pass, until they arrive, transformed and purified, in the plexuses of the cortical substance which are

set in motion, impressed and vivified by them alone;" and again, "The connections between the peripheral plexuses and those of the sensorium are so intimate that, so soon as an impression has been produced in the former, their partner cerebral regions immediately enter into unison with them. There is a nervous condition of similar pitch which harmonises one part with another, and whenever the primordial impression has been sufficiently intense and sufficiently prolonged, whenever there has been an effective participation of the nervous plexuses laid under contribution, the partner plexuses of the sensorium sympathetically associate in their excitation and enter upon a concordant period of erethism. The incident excitation arrives then in the plexuses of the cortical substance purified and animalised by the peculiar metabolic action of the nervous plexuses, in the womb of which it is incarnated, and then transforming itself into a psychic excitation it develops the latent energies proper to the cerebral cells, imprints itself upon them, and perpetuates itself in them in the form of persistent vibrations like a phosphoric gleam of the external world." These are the words you will observe of one who sneers at philosophers and metaphysicians for displaying in sonorous language their ignorance more or less complete of the fundamental characters of psychical life. And this is the kind of writing that we are asked to accept as conveying the last verdict of scientific physiology concerning ourselves. By the assumption of phosphorescence, of specific vibrations, and of inherent sensibility, none of which functions or properties have been proved to exist, and concerning which no shadow of proof is attempted; by the further assumption that these purely imaginary qualities are inherent in bodies (the cerebral cells), of the intimate structure and composition of which he, like everybody else, is profoundly ignorant, M. Luys pretends to be able to explain the most complex

problems of mind. One of the mysteries which philosophers and metaphysicians have hitherto been unable to elucidate is memory, and the changes which it frequently undergoes in the aged. All this, however, is abundantly clear to M. Luys. Give him the cerebral cell to start with—for I have gone very carefully through every line of the last edition of his book without being able to find any receipt as yet for the manufacture of that body; let it, however, be produced somehow—and memory, like every other function of mind, follows as a natural consequence. "The nervous elements," he remarks, "like bodies which have received the vibrations of light, preserve for a long period traces of the excitations which have in the first place set them in action, thus storing up within themselves phosphorescent traces which are records of the received impressions;" and again, "I have proposed to apply the term phosphorescence to that curious property the nervous elements possess of remaining for a longer or shorter time in the states of vibration into which they have been thrown by the arrival of external excitation—as we see phosphorescent substances illuminated by solar rays continue to shine after the source of light which has illuminated them has disappeared." Memory then being nothing more nor less than "nervous phosphorescence," the reason of the strange change in that faculty in the aged, whereby they can remember long past but not recent events, is again perfectly clear; for in these—the aged—"the cells of the sensorium, altered in their essential constituents, have *become lazy* and incapable of erecting themselves in the presence of recent impressions, and thus this state of torpidity of the elements of the sensorium for new excitations leaves the field free to the older ones, which, not being obscured by more lively impressions, continue to vibrate without opposition, and thus to perpetuate the last phosphorescent gleams of a far off past which is dying." In

a similarly clear manner the development of our ideas of good and evil, of happiness and misery, of the will, of judgment, and of every other mental faculty is set forth. I must trouble you with one more quotation of a passage in which the author sums up, as it were, his conclusions on some of those difficult problems of life and mind which, after many ages of darkness and mystery, he considers it to have been his happy destiny to make completely clear, and you will be able to see from it how thoroughly the object set forth in his preface, viz., that of carrying "the data of contemporary physiology into the hitherto uninvaded domain of speculative psychology" has been attained, and how completely it has warranted his own modest statement in the same preface, "that, in a word, there is from this time forth a true physiology of the brain as legitimately established, as legitimately constituted as that of the heart, lungs, or muscular tissue." The passage is as follows:—"We see, then, to sum up what precedes, that the processes which produce voluntary motion pass in their evolution through phases inverse to those of the processes of sensibility. While those latter as they approach to the central regions of the sensorium are purified and made perfect, being more and more intellectualised by the metabolic action of the different nervous media through which they are propagated; the former, on the contrary, conceived as psychical vibrations at the moment of their genesis, amplify, and are materialised more and more as they descend from superior regions. They become complicated by the addition of adventitious elements, which reinforce them as they progress, . . . and thus become in the last term of their evolution a true synthesis of agglomerated dynamic elements, which resume in themselves the vital forces of the system through which they have been developed." "Conceived under this simple formula," says the author, "the processes which produce voluntary motion

present the fascinating picture we constantly see presented to us in the working of steam engines."

I have made these long quotations that there might be no chance of misrepresenting the author's meaning. But having done this with M. Luys, it will be the less necessary to do so with others whose positions are substantially his. Man with them is an irregularly evolved machine, with the working of which, self-consciousness and a delusive feeling of freedom and hence of accountability for conduct * has, by some strange bungle of nature, become inconveniently mixed up. Starting from the earliest animal, everything up to his appearance on the earth went smoothly enough. No doubt, to an intelligent outsider, who could have watched the whole process of evolution up to and throughout plant and animal life short of man, the manifestation at one of its stages of vitality, and at a later one of pleasure and pain, must have been very startling events; but these having been once established, the harmonious relation between organism and environment would explain everything else. Internal impulses, instincts, and appetites, finding their satisfaction in such an adapted environment, the instincts and appetites being true instincts and appetites whose promptings might safely be trusted, and the environment a true environment fitted to yield them satisfaction, would everywhere be observed throughout the ascending series of animal life. There would be no mistake, delusion, or mistrust anywhere. One creature after another, finding itself the possessor of certain faculties, would be observed to exercise those faculties without the slightest misgiving, and to derive advantage from the exercise. But no sooner does man appear than all is supposed to be changed. He undoubtedly feels within him-

* ". . . . by a strange phenomenon of which *we are incessantly the dupes*, it comes to light in the form of *spontaneity* in our ideas, our words, our acts."—Luys, p, 231.

self spiritual cravings which desire satisfaction, just as the appetites of lower creatures do; but he is informed by certain philosophers that now, for the first time in the history of the earth, the relation of truth previously subsisting between inward feelings and something answering to them in the environment is broken, and that he must regard all such cravings merely as so many delusions. He is conscious, also, of a strong sense of moral freedom, which he is driven irresistibly to trust to as a genuine part of his nature, yet this, he is is informed, is nothing but a delusion.* For freewill, in the metaphysical sense, is a myth. Physiological microscopists have looked for it carefully, with the very highest microscopic powers, and with the most refined methods at their disposal, and they can no more discover it than can the philosophical statists whose verdict I have already quoted, and therefore, of course, it cannot exist. Everything is explicable on physical theories, and by purely physical processes. Actions and interactions between stimuli and nerve cells, which the subjects of them can no more control than they can the growth of their hair or nails, must in one way or another be made to account for remorse, anger, will, and every other quality of mind; and this being so, they are made to account for them, and that in so simple a way that the wonder is that so many ages could have elapsed before the discovery was made, and that there can still be found great numbers of apparently intelligent people who discredit it. Possibly, as Dr. Luys suggests, the delay in the discovery was caused by want of knowledge of the hardening powers of chromic acid over nervous tissues, which, in his opinion and language, "has been one of those new methods in laboratory work which has most essentially contributed to the success of those great achievements in

* Vide *Types of Ethical Theory*, vol. ii, p. 360, *et seq.*, where this phase of the subject is discussed with great force and clearness.

this particular domain of anatomical science which our own century has witnessed." If Varolius and Glisson, not to go back to Aristotle and the Greek ethical philosophers, had only lighted on this slight but happy discovery, and at the same time had been blest with high power immersion lenses, and the knowledge of a few chemical principles, the realm of ethics and psychology would not have remained unilluminated so long. The facts that neither observation nor experiment has ever yet succeeded in tracing the living from the not-living,* and that to most men's conceptions there are absolute barriers unremovable by the most skilful intellectual engineering between the not-conscious and the conscious, and between the not-moral and the moral, so that it is impossible for them to conceive of the transition from the one state to the other as the result of a mere unbroken process of evolution does not disturb the equanimity of these gentlemen. What cannot be proved can easily be taken for granted, and if any obstinate individual seems indisposed to accept their postulates, it is surely reply enough to say that he is ignorant of physiological methods applied to psychology, and the whole thing is settled. "It is the superaddition of consciousness," says Dr. Maudsley, "to definite susceptibility to impressions, and definite reaction thereto, which are common properties of all organic matter, that makes them sensation and effort," as though this superaddition were the most trivial event in the world, which all men were able constantly to witness if they chose, and which had but to be alluded to in this off-hand way in order to gain

* Huxley's *Anatomy of the Invertebrate Animals*, p. 39. "The fact is that at the present moment there is not a shadow of trustworthy direct evidence that abiogenesis does take place, or has taken place within the period during which the existence of life on the globe is recorded."

"The present state of our knowledge furnishes us with no link between the living and the not-living."—"Biology," *Encyclopædia Britannica*, 9th edition.

instantaneous and universal recognition of its truth. Even Haeckel, recognising, as Dr. Maudsley does not appear to do, the logical danger of allowing the possibility of the superaddition of properties not originally inherent in matter, assumes the existence of a power of choice—(sensation, will, and a soul,)—in the so-called atoms, in order to account for chemical affinities; so that man, who feels impelled by many imperious promptings of his nature to believe that he has a will and a soul, is to be denied them, while to the atoms, which in most men's opinions are wholly indifferent about the question, they are to be granted; and this double act of violence is to be committed for no other reason, apparently, than to give consistency to a theory which without it is felt by its authors to be wanting in logical completeness.

It must not be thought that the chief merit of the discovery of this new and blessed philosophy of humanity is due to French genius. Many a quotation from German and American physiologists might be given to prove that it is not so, while it would be unjust to those of our own country not to shew by one or two illustrative examples how successfully they also can apply physiological methods to the elucidation of ethical and psychological problems. Dr. Maudsley's book was published in 1883. In it he, like Dr. Luys, deals very severely with the mere philosophers and metaphysicians who have preceded him, and tells us that he has no alternative "but to leave the barren heights of speculation for the plains on which men live and move and have their being." He is particularly hard on the "philosophers of the study," who, as he says, "indulge in vagueness of thought and expression, and seem to be unable to get clear and exact notions of psychological facts in their mental relations;" so that we turn to him in a spirit of quiet confidence that at last everything *will* be clear and exact, and that they are so, one or two quotations will be sufficient to

prove. Thus, among a great number of passages equally lucid, and expressed with equal dogmatism, he speaks, at page 80, of sensations as "themselves representing the sum of multitudes of activities that are going on below the threshold of consciousness, and which, albeit unperceived and unfelt, immediately vibrate subtilely in the most intimate and intricate interactions of organic depths, and in the result affect deeply the tone of consciousness;" while at page 132, in one of the chapters on "will in its physiological aspect," we are taught that there are "two leading facts, and for us ultimate facts, which it behoves us to apprehend and fix firmly in mind—first that there has been what we may call a *nisus* of nature, and secondly that successive transpeciations of matter have been events of it. Continuity of nature certainly, but as certainly not of kind in nature; for the continuity is of different kinds, therefore in some sort a discontinuity, a new springing up from the bases of the old kind; not continuity by homogeneous but by hetereogeneous generation." Having then happily outlived the age when men expressed in sonorous language their ignorance, more or less complete, of the fundamental characters of psychical life, we find, from the marvellously lucid expositions of modern science that I have read to you, how far from the truth the general conceptions of humanity have been.

We certainly believe that we have the power to choose freely between several courses of conduct, and when we have done a certain thing, which on reflection we find to have been mistakenly done, and when having to do it again, we do it differently so as to avoid the mistake, we are apt foolishly to think, and others are apt foolishly to think of us, that we could have acted differently from what we did on the first occasion if we had chosen to do so. But in this we are told that we are wrong, for Dr. Maudsley thus speaks of every possible human action, viz.:—that the doer of it "certainly

could not have done otherwise than as he did on that occasion, but he is not therefore fatebound to do the same on another occasion;" while, in slightly modified language, we are informed by a second guide that "our character organisations being what they are, they are bound to react as they do react, and in no other way, to the motive stimuli that act upon them. The brain is a variable piece of mechanism, and acting variably at different times we think it is free."*

It seems needless to ask whether any of the facts of our modern social life contrast with these lofty views of humanity. The difficulty would be to find any in accordance with them. For there is not only the fact stated above that all men certainly feel that they have a true power of choice, but the additional ones that all their actions towards each other are founded on their belief in the truth and genuineness of this feeling, and that some kinds of judicial punishments exist among at least all such of them as are civilised, by which that belief is practically emphasised and enforced, often in a most disagreeable manner, on the attention of any apparent dissentients. But in the language of one who will not be regarded as having a weak bias towards metaphysics, viz., Mr. Romanes, "In all cases where there is a general consensus of this kind, there is an antecedent presumption that the common sense of which it is the expression is in the right, and that any ingeniously constructed argument of scepticism is wrong." Most people will probably agree with this. What then may be taken to indicate a general consensus of opinion? If almost all mankind, learned and unlearned alike, feel impelled by the facts of self-consciousness to believe a certain thing; if they believe it so firmly that it serves as the basis of their commonest and most cherished institutions; if it is so ingrained in their minds that their very language would have to be remodelled if it ceased to be

* *Nature*, Feb. 14, 1884, p. 371; *Nature*, Feb. 21, 1884, pp. 379, 380.

believed, would all this imply such a general consensus of feeling as to raise a presumption that the common sense of which it is the expression was in the right, and ingeniously constructed arguments of scepticism in the wrong? But that our most cherished institutions, as well as those of all civilised people, have their foundations in a belief in human accountability, which presupposes human freedom, is obvious enough. Courts for determining the punishments to be awarded to the doers of what are now spoken of as wrong deeds would no longer be courts of justice, but of the grossest injustice, if the perpetrators of those deeds certainly could not have done otherwise than they did. And if anyone will take the trouble to go through an ordinary English dictionary, and strike out all words such as "right," "ought," "duty," "obligation," "justice," &c., which derive their force and their sole force from this belief, he will probably be surprised at the extent and depth of the modification which our language would have to undergo if it were abandoned.

If, moreover, the effect of a thorough impregnation of all men's minds with this scepticism concerning their freedom of will and moral responsibility were to extinguish all high and noble endeavour, and to loosen all social ties, would this increase the probability that the belief was a well founded one? Yet, probably most people will think that such *would* be the result if the belief could be universally extinguished. I am quite aware that Mr. Herbert Spencer has constructed an ideal society towards which man is supposed to be evolving, but which can only be reached when "the sense of duty or moral obligation, which is but transitory, shall have diminished and passed away, and when all the ordinary sanctions—religious, legal, and social—will be no longer necessary;" though it is supposed by Mr. Spencer that, even in his most perfectly evolved condition, man will still require for times of extraordinary temptation that sense of obligation

which helps him so effectually now. "With complete evolution," he says, "the sense of obligation not ordinarily present in consciousness will be awakened only on those extraordinary occasions that prompt breach of the laws otherwise spontaneously conformed to." * That any such spontaneous conformity to law could ever replace the gradual obliteration from the consciousness of those sanctions to right-doing, which in our present state are felt to be as necessary as they are powerful, is open to the gravest doubt. And not only the superior happiness, but even the possibility of the long continued existence, of a society of men, among whom they should fail to be recognised, is questioned by many men of thoughtful minds. "It is now well known," says M. Taine, "that vice and virtue are products exactly like sugar and vitriol, and we may hope to know in time the laws by which they are produced. When science has clearly established these laws, it will be as irrational to feel indignation at base and cowardly actions as it would be to feel angry at the chemical affinities. A clever insight into the laws of nature will rid us, I feel sure, of the very disagreeable feelings of regret and remorse. But I feel it difficult to conceive of a society from which science has eliminated all idea of responsibility, and still more difficult to understand how the modern ideas can be taught to the young in our schools without fatally weakening every youthful effort." While Dr. Carpenter, who quotes this passage, himself writes, "I can imagine nothing more paralysing to every virtuous effort, more withering to every noble aspiration, than that our children should be brought up in the belief that their characters are entirely formed *for* them by heredity and environments; that they *must* do whatever their respective characters impel them to do; that they have no other power of resisting temptations to evil than such as

* *Data of Ethics*, p. 181.

may spontaneously arise from the knowledge they have acquired of what they ought or ought not to do; that if this motive proves too weak they can do nothing of themselves to intensify and strengthen it; that the notion of 'summoning their resolution' or 'bracing themselves for the conflict' is altogether a delusion; that, *in fine*, they are in the position of a man who is floating down stream in a boat without oars towards a dangerous cataract, and can only be rescued by the interposition of some *Deus ex machinâ*." *

M. Luys speaks in such confident tones of what he claims to have discovered that it may be well to occupy a few moments in considering how far that claim appears to be justified. His chief, if not sole, reliance is based on the revelations afforded to him by the microscope. "Let us," he says, "penetrate by means of magnifying glasses into the interior of this soft substance"—the brain. "Let us push our researches still further by means of thin sections rendered transparent and methodically coloured; let us employ gradually increasing powers to pass from a known to an unknown region and we shall then be able to penetrate into those almost unknown regions of the world of the infinitely little, and, like travellers returned from distant lands, to bring back indisputably faithful reproductions of the details which have struck us," and later on he claims to have done all this, and to have brought back a faithful account of details, and hence to be justified in speaking as he does. Certainly he has described strange appearances which no one else has observed, but as these seem to bear no relation whatever to his conclusions they need not be mentioned here. The question for us is how far the microscope, even if it be the very best, and no evidence is afforded to us that M. Luys has employed the very best, can assist in an enquiry of this kind. It is estimated by Helmholtz that the

* *Contemporary Review*, vol. 25, p. 952.

smallest particle of matter definable by the best modern microscopes is one of about the $\frac{1}{80000}$th of an inch in diameter. If such a particle were a sphere of water it is calculated by another eminent physicist (Mr. Sorby) that it would contain 8,000,000,000 molecules, or, as each molecule consists of three atoms, of 24,000,000,000 atoms, supposing these to be possibly separable.* On this estimate, how far would one be warranted, from being able to see plainly a piece of any substance the 80,000th of an inch in diameter, in claiming to have penetrated far enough into the world of the infinitely little to sanction his using language which could only be used with the least approach to propriety if he were acquainted with its ultimate molecular composition? The reply will best be given by a homely comparison. Suppose one can see a face and describe its features with fair accuracy at a distance of thirty feet, it would be as though, on the strength of such capability, he should claim to be able to gain, by the naked eye alone, indisputably faithful details of other faces as far removed from him as we are from Shrewsbury or Lancaster. In other words, the comparison would be between 30 feet and 57 miles.

Admittedly things look very different when seen under a low power than when seen by the naked eye, and still more different when seen under a high than under a low power, more and more details coming successively into view. But the distance which the very highest power can carry us along the road towards the ultimate composition of things, is very

* Dr. Lionel Beale has more recently stated that bodies less than $\frac{1}{100000}$th of an inch can be defined; but, on the other hand, Sir W. Thomson has considered the size of molecules to be so minute that about the same relation would be maintained as stated above. The hinder cilium of a Heteromita, observed by Dallinger and Drysdale, was not much more than $\frac{1}{100000}$th of an inch in thickness, while the granules discharged from the body, though too minute for measurement, were thought to be probably less than $\frac{1}{800000}$th of an inch in diameter. These are among the minutest sizes up to the present spoken of as having been possibly seen.

very small indeed compared with the immensely greater distance to be travelled before we could hope to reach it. As, however, the appearances successively observed at every stage of even the extremely short distance traversed are all different from each other, the probability is that these appearances would go on differing during the whole of the remainder of the journey, and that, therefore, there is no ground whatever for assuming to have established any acquaintance with ultimate molecular structure, and still less to have established any relation between such ultimate structure and states of consciousness from what has been done by the aid of the microscope.

Of course it would be rash to place limits on the possibilities open to the microscope, and it would be as useless as it would be wrong to deprecate its application to the investigation of the intimate structure of nervous or any other tissues. It is to be hoped that such application will be made with ever increasing ardour as time goes on, as it is certain that valuable results will thus be gained. The objection is not to legitimate use, but to illegitimate inference from possibly correctly reported observations; and the "fresh light" that M. Luys claims to have thrown "upon the intimate structure of the nerve cell and on the organisation of its protoplasm" is, so far as any elucidation of the nature of mind is concerned, like light thrown on the outer walls of a closed and dark chamber with the view of discovering its contents.

Another of the lessons taught by modern science and applied by her to man is the advantage of force. For more than forty years Mr. Herbert Spencer with rare ability and eloquence has been unfolding before men's minds the great doctrines taught by nature, and in the crowning work especially—the *Data of Ethics*—he enforces by a great variety of illustration the high morality of taking care of

oneself. The man who, to pay off a debt, or to support those who are looking to him for help, works so hard as to injure his health, is guilty of conduct similar in kind, even if differing in degree, from that of him who injures his health by what in the present stage of our evolution we foolishly distinguish as vicious courses. "Strange as the conclusion looks, it is nevertheless a conclusion to be here drawn," writes Mr. Spencer, "that the performance of every function is in a sense a moral obligation." It does seem strange, certainly, to associate him who is deaf and dumb with him who uses his ears to listen to evil reports and his tongue to diffuse them; and no doubt it will be a long time before society is instructed enough in philosophy to be able to recognise the fundamental unity underlying the departures from normal processes which they now in thought and practice so widely separate from each other. Yet "non-recognition of these general truths," we are assured, "vitiates moral speculation at large," and by "recognising the evils caused by some kinds of conduct only," the kind of conduct for example which is generally designated as morally unworthy or vicious —"men at large, and moralists, as exponents of their beliefs, ignore the suffering and death daily caused around them by disregard of that guidance which has established itself in the course of evolution." Well! if there is any one principle established more clearly than another by the process of evolution, it is the advantage of having and exercising a force superior to that which is possessed and exercised by competitors in the great struggle for existence, so as to ensure the final survival of the fittest; and if any great lesson of conduct is to be learned from the operation of this principle, it surely should be that it is the highest duty of everybody to make his own strength stronger, that he himself as the fittest may survive, and to let his weaker neighbour grow weaker still, that he may die out, and not

disturb the uniformity of the process by which a higher standard of humanity is to be evolved. Yet the peculiarity which seems specially to distinguish man in nature, and to distinguish him more and more as he becomes more and more civilised, is his intentional disregard of this principle. For what does he do? He builds hospitals for the sick, keeps alive the infirm, cherishes the debilitated and the maimed, and in a thousand other ways strives to keep alive weak, useless, and—on any narrow interpretation of that "guidance which has established itself in the course of evolution"—injurious organisms, and by thus running counter to the otherwise universal law, demonstrates his essential superiority to it. He can consciously do what, up to the point of his own appearance on the stage of existence, has seemed an impossibility; and again it becomes a question whether a being who recognizes the operation of a great law, and, recognizing it, yet of set purpose and knowing fully what he is about, deliberately turns his back upon it and sets up another and antagonistic law, can himself be nothing more than the blind and necessary outcome of the operation of the law which he thus opposes.

The one universal rule of nature, applicable alike to man and all sentient creatures below him in the scale, is the desire for happiness. To this there is no exception. It is without exception, also, that he and they seek what they desire; so that any pains which men now endure are submitted to as part of that lot in life which, on a consideration of all the possibilities open to them, seems to offer them most happiness. It will be on similar judgments that the decisions of men as to the kind of life which they shall follow will always rest. "The peasant crippled with rheumatism due to exposure," consequent on "persevering in actions repugnant to the sensations, and neglecting actions which the sensations prompt"—whom, along with others, Mr. Spencer holds up as

examples of the folly of a shortsighted view of pleasures and pains—as his end drew near, would not, in all probability, think that he had made any very great mistake, when, with the consciousness of having lived an honourable and useful life, and, it may be, of having reared a family in respectability, he compared the balance of his pleasures and pains with that of some companion peasant, who, early taught in the most modern school of philosophy that his highest interest was not to perform actions repugnant to his sensations, and not to neglect those which his sensations prompted, began his career by ceasing to work, and seeking the shelter of his home whenever it rained or the north wind blew. It is possible that such a man might escape being crippled with rheumatism, though even that is only a possibility. It is certain that he would escape being a hero, even in humble life; for heroism of any kind would seem to be an impossibility under a rule which should require all alike to shun actions repugnant to the sensations, and to follow only those which the sensations should prompt. And "if the rules of right living are those of which the total results, individual and general, direct and indirect, are most conducive to human happiness," as Mr. Spencer maintains, the probabilities that he had made the better choice would be largely against the philosophically instructed peasant, and in favour of his non-philosophical friend, whose simpler views of life, founded on old-fashioned notions of duty, had led him to disregard consequences when such duty had to be done.

But the contrast between what men think themselves to be, and what science says they ought to think themselves to be, does not end here. To the vast majority of mankind, the belief that there are things external to their conscious selves is as strong as that they themselves are conscious. Subject and object are, or at any rate are believed to be, strictly correlative. Rigidly to establish the existence of

such external things by scientific proof would perhaps be an impossibility. It is fortunate, therefore, that the necessity for this is not felt, for to most people it would appear as needless a task to try and prove to them that they had material bodies, as it would be hopeless to try and convince them that they had not. Yet once again in the world's history we are positively assured that such a belief is one of the crudities that will disappear before the enlightened teaching of a more advanced science; for we are informed that the supposed primary principle which gives force to this belief, viz., that motion cannot exist without something to be moved, will not bear examination, being a mere "fallacious conviction, traceable to the limited character of the experience of motions which we and our ancestry, from the first dawn of organised thought on the earth, have had within reach of our senses." And further, that as "no scientific investigation has as yet detected anything but motion, . . . we therefore are not in a position to allege that we know anything existing in the outer world but motions and relations between motions." It is easily conceivable that it is to the extremely rapid but minute motions of molecules that the quality which is interpreted by the mind, in one case as colour, and in another as hardness, is due; and that if the rapidity of the movements be altered the resulting sensations are altered also; but that there are no material molecules thus rapidly to be set in motion does not seem conceivable to the ordinary mind, however it may be to those very few who have emancipated themselves from the errors in which all the rest of the world is lying. The way in which we ought to speak of things is shewn by an illustrative example given by Dr. Johnstone Stoney, in reply to the Duke of Argyll, who had expressed his difficulty in forming this conception. It is as follows :—"When the vast accumulation of molecular motions which is *called* my

finger, approaches that other accumulation of motions which is *called* a rock, these motions act upon each other, and my finger is compressed upon certain nerves, exciting them to produce those motions within my brain, which, though quite unlike the motions outside, are the motions that are really accompanied by the sensation of hardness." * The tyranny of false teaching is evidently very great, for clearly what ought to have been said above is not "nerves" and "brain," as though these had some substantiality not possessed by the finger and rock, but 'those accumulations of motions which are *called* my nerves and my brain.' But it is not, perhaps, right to find fault with seeming inconsistencies of expression, for, as one of the most advanced of the modern philosophers has himself recently said, "Till language has been brought into uniformity with philosophic thought, all attempts to express the undiluted truth must be more or less failures." This conclusion must, however, land us in despair, for as philosophic thought is constantly advancing language must necessarily always lag behind it, so that obviously we can never be made acquainted with the undiluted truth by the only possible channel through which it can be conveyed to us in our present state of existence.

Dr. Stoney's statement as to the non-provability of the existence of matter, or of a thing to be moved, seems to be so absolute as to admit of no possible exception. Yet it is not unlikely that even he would allow of one exception. At any rate, others are willing to do so; for near the time when the above utterances were being made by him to an enlightened English audience, Sir William Thomson was thus addressing an enlightened American one: — "You can imagine particles of something, the thing whose motion constitutes light. This is the only substance we are confident of in dynamics. One thing we are sure of, and

* *Nature*, vol. xxxi, pp. 422 and 539.

that is the reality and substantiality of the luminiferous ether."

There is one noticeable fact in many of these scientific declarations, viz., that in the last resort the appeal is always made to a something within us, whose testimony does not, or is supposed not to, deceive. Thus in the lecture to which allusion has already been made, Sir W. Thomson asks, "Can you suppose an end of matter or an end of space? The idea is incomprehensible. Even if you were to go millions and millions of miles, the idea of coming to end is incomprehensible," and *hence*, *i.e.*, because the mind cannot conceive of limits, matter and space are illimitable. And this occurs again and again, certain postulates being always implied, such as that that which is inconceivable by the mind cannot exist, or that that which the mind cannot conceive as non-existent must exist. So Dr. Maudsley writes, "Not to think the existence of the not-self is as impossible as to think the non-existence of self—indeed to think the existence of one without the other is unachievable;" and Dr. Büchner, making a similar appeal, says, "We cannot, *even in thought*, remove or add an atom without admitting that the world would be thereby disturbed," the implication being that what we cannot do in thought is not do-able—the two latter propositions being adduced, not from any concern which I feel about their truth or falsity, but merely as affording illustration of the necessity which is everywhere recognised of such an appeal in the last resort, and of the supposed wisdom of trusting to the verdict given.

Of course, it is not pretended that the mere assent to a proposition, even if that assent should be all but universal, would justify us in regarding it as certainly true, for doubtless many a proposition, now known to be erroneous, was once thus universally accepted as true. It is only when the

testimony to its truth depends on the unalterable nature of the consciousness, and hence is independent of any advance in mere knowledge, that it is thus reliable. And this being so, and as long as it is so, the foundations of humanity, laid in its ever-enduring beliefs, will rest secure. Philosophic systems may come and go, and the structure reared on our moral intuitions will remain unaffected; for to the vast majority of men it will be more difficult, by any amount of mental torture, to persuade them out of the belief that they are morally responsible creatures, possessed of a real freedom of choice, than it will be to persuade them that space and matter are finite, that the addition of an atom to matter is a possibility, or that there *may* be a self without a not-self.

As between things, and the appearance of things, it comes then to this, that science cannot prove that things do not exist. All she can do is to confess her powerlessness to prove that they do exist. In the last analysis she can find nothing but motion, and to the question whether therefore there is nothing else, the kind of answer given will greatly depend on the answer given to the further question, "Are we to believe in nothing that cannot be scientifically proved?" Is such an apparently ineradicable conviction, for example, that there is an absolutely necessary relation between motion and something to be moved, so that it is impossible to most minds to think of the first without thinking of the second in connection with it, really a fallacious conviction arising out of a too limited experience, or is it a trustworthy belief, more trustworthy than the ingeniously constructed argument of the philosophic scepticism which is opposed to it?

Some words of Pascal, old as they are, seem so applicable to the present controversy that I am tempted to quote them. "The sole strength of the dogmatists," he writes, "consists in this, that speaking in good faith and sincerely one cannot

doubt natural principles. We know truth not only by reason, but also by feeling, and by a living and luminous intelligence. It is from this last that our cognition of first principles proceeds, and it is in vain that the reason which has no place here seeks to combat them. . . . We know that we are not dreaming, however powerless we may be to prove it by reason; this powerlessness simply shows the feebleness of our reason, not the uncertainty of our cognitions. For the cognition of first principles, as that there are space, time, motion, numbers, matter, is as firm as any which our reason gives us. And it is upon these cognitions that the reason builds. I feel that there are three dimensions in space, and that numbers are infinite; and reason immediately demonstrates that there are no two squared numbers of which one can be double of the other. Principles are felt, propositions proved, and both with certainty, though by different methods, and it is as ridiculous for the reason to demand from the feeling and intelligence proofs of its first principles before it is willing to admit them, as it would be for the intelligence to demand from the reason a sentiment concerning all the propositions that it demonstrates before she would receive them. This powerlessness ought merely to humble reason which would desire to make itself judge of everything, and not to combat our certainty as if reason alone were capable of instructing us."

As to the necessity of some standard external to the individual, by which to judge ultimately of the rightness or otherwise of conduct, it seems to me to be implied in the ethical systems of those philosophers who in words deny it, so that the unconscious testimony thus given must confirm the belief of those who have it in the strength and universality of the sentiment that impels the individual man to look beyond himself for guidance. Thus Mr. J. S. Mill, one of the ablest and sincerest of modern philosophical

thinkers, while stating that "the ultimate end . . . is an existence exempt as far as possible from pain, and as rich as possible in enjoyment, both in point of quantity and quality," tells the anxious enquirer, who, recognising the additional statement by the same authority, "that some *kinds* of pleasure are more desirable and more valuable than others," asks how he is to know which kind is best for him, that "the test of quality, and the rule for measuring it against quantity, is the preference felt by those who in their opportunities of experience, to which must be added their habits of self-consciousness and self-observation, are best furnished with the means of comparison," *i.e.*, he is to go out of himself to some authoritative guide, though who that authoritative guide is to be seems to be left very much a matter of chance, as probably each philosopher that should be consulted, however widely he may differ from others as to what kind of pleasure is to be preferred, or though he may object as some do to the question of quality being introduced at all, would no doubt consider himself to be the one best furnished with the means of comparison, arising out of his large opportunities of experience, added to his habits of self-consciousness and self-observation, and hence the best qualified to give a decisive answer.

And that in many other respects the lives of philosophers are marvellously divergent from their theories, that in them, as in more ordinary men, natural impulses and natural sentiments will assert themselves, and thus give the lie to the systems which would make them out to be something entirely different from what they seem to be, is obvious enough. In proof of this, I cannot do better than quote the words of one of the most distinguished occupants of this chair, who, at fourscore, when most men shew signs of decay, has given proof in the production of that great and opportune work, the *Types of Ethical Theory*, of almost

unexampled vigour and freshness of intellect. I allude to Dr. Martineau, who thus writes, "the philosopher's thought is seldom the exact, and never the coloured photograph of himself; it shows him as he sits still and meditates, not as he lives and moves and has his being; and did we see in him the flush of indignation, or the surprise of grief, or the melting of contrition, startling images would pass before us that would seem impossible to emerge from that calm statuesque figure. He is not an intellectual automaton stirred by the waves of speculation; the instincts of nature rush in and interpolate many a burst of action and affection which the logical reason cannot overtake. With a noble inconsistency, all the great writers whose doctrines we have studied betray the tenacious vitality of the intuitive consciousness of duty throughout the very process of cutting away its philosophic roots; and Plato, in his divine wrath at the tyrant flung into Tartarus; Malebranche, self-extinguished in the Absolute Holiness; Spinoza, lifted from the thraldom of passion into the freedom of Infinite Love; Comte, on his knees before the image of a Perfect Humanity, are touching witnesses to the undying fires of moral faith and aspiration." *

* *Types of Ethical Theory*, vol. i, pp. 478–9.

# A NOBLE FAMILY OF THE MIDDLE AGES.

## *(BRANDON, DUKE OF SUFFOLK.)*

By JOSIAH MARPLES.

On the 22nd August, 1485, a little more than four hundred years ago, was fought the battle of Bosworth Field, in which Henry, Earl of Richmond, defeated King Richard III, and gained for himself the throne of England, which he occupied as Henry VII. The final episode of this battle, which terminated the Wars of the Roses that had devasted England for thirty years, and cost the lives of upwards of one hundred thousand men, was a stirring one. The battle had but just begun, when Richard, finding that some of the captains upon whom he relied were deserting him, determined to make the fight a personal one, and; calling on those immediately around to follow him, he went to the front, sword in hand, determined to cut his way to Henry or die in the attempt. In a book written in the last century, by a gentleman who resided in the neighbourhood and made the battle the subject of much study and research, the following graphic account occurs. "Though Richard took his spear he did not use it, but trusted to his sword. Sir William Brandon, the Earl's standard bearer, was the first person he approached, who, fascinated as with a baslisk, at the intrepid boldness of the king, could neither resist nor depart, but seemed to fall by his own astonishment. Richard at one stroke cleft his head, seized the standard, and with a vengeance threw it to the ground.*" A contemporary manuscript, written by one

* Hutton's *Battle of Bosworth Field*, published by Nicholls in 1818, p. 110.

who was apparently an eye-witness, says, "Amongst all othar, I remembar tow, Sir William Brand was the one of tho; Kynge Henry's standard he heryd on hye, and vamisyd it tyll with deathe's dent he was stryken doune.*" Sir William Brandon was the only person of note who fell on the side of Henry, adds our first author.† Little or nothing is known of Brandon's previous history, but the loss of his life in such a manner, on such an occasion, was a good title to remembrance, and one of the early acts of the new king was to adopt Brandon's young son, Charles, who was brought up at court as one of the royal pages. In those warlike times the transition from the court to the camp was an easy one, and during the intervals of peace, those who had acted valiantly in war were sure of a hearty reception in the court. Charles Brandon grew up to be remarkable for his strength and stature, and his chivalrous bearing made him a special favourite with that fair portion of the court whose privilege it was to reward the valour of the warriors.

Soon after his accession to the throne, Henry VII married Elizabeth, the representative of the rival house of York, by whom he had four children: Arthur, who died before his father; Margaret, who became Queen of Scotland and ancestress of the Stewart line of English kings; Henry, our "bluff King Hal"; and Mary. As these children grew up together with Charles Brandon, he naturally had good opportunities of endearing himself to them if he cared. While he became a famous soldier, the young princesses were becoming women, and there can be little doubt that the younger of them, Mary, conceived a deep admiration and affection for the gallant and handsome page and knight. Mary, however, for political reasons had, when four years old, been betrothed to the Dauphin, and at eight years old

* Harl. MSS., 542, fol. 34.

† Hutton, p. 140.

to Charles, Prince of Castille, afterwards the Emperor Charles V; while Brandon solaced himself when away from the court with an engagement to a girl of low degree, whom he discarded however for a second cousin, who was more suitable to him in position. This marriage becoming distasteful to him, he found out, as his royal master did after him, that she was within the prohibited degrees of consanguinity to the girl to whom he had previously been betrothed, so he declared the marriage void, and returned again to his first love, Ann Brown, only to cast her off again on some excuse when it suited him. In 1512 he was nominated captain of the "Sovereign," when he had a narrow escape of his life, for the companion ship, the "Regent," with 700 men, took fire and exploded, burning at the same time a French corvette with 900 men, and almost all the crews of both ships were lost. In May, 1513, Brandon arranged to marry the daughter and heiress of Viscount Lisle, in consideration of which the king conferred upon him the vacant barony, and made him Lord Lisle. As the young lady was at the time only nine years of age there was plenty of opportunity for other arrangements to intervene. In the following month, the new lord went with Henry VIII into France to meet the Emperor Maximilian, who was accompanied by his daughter Margaret, Duchess of Savoy, regent of the Netherlands, and, as such, a near neighbour to our colony at Calais. During this visit an amusing episode occurred. Henry was anxious to push the fortunes of his favourite, and induced him to pay his addresses to the Duchess Margaret, who was at that time a widow. The matrimonial ventures of this lady had not been fortunate. She was born in 1479; in 1482, when she was at the mature age of three, she was affianced to the Dauphin, afterwards Charles VIII of France; in 1493 this match was broken off. In 1495, when only sixteen, she was actually married to

John, Prince of Spain, who died in 1497. In 1501 she married Philibert, Duke of Savoy; he died in 1504. Our own Henry VII was her next suitor in 1508, but his death in 1509 put an end to the negotiations; and in 1513 she was open to receive offers.

The story of her next courtship, that with Brandon, is detailed in Hall's *Chronicle*, but the most amusing touches in it are given in Margaret's own letters to her ambassador in England,* to whom she wrote full particulars in order that he might be posted up, and be able either to confirm or contradict the report of the projected marriage as might appear wise to him. She describes Brandon as a "jentyll-mann" of "much vertwe and grace of person," and details how he took a ring off her finger and put it on his own. She said he was a thief, and wondered that so great a king as Henry should have brought thieves over in his suite. Brandon pretended not to understand what she meant, so she appealed to the king, saying that her ring was much too well known for it to be seen on Brandon's hand, and she bought it back with one of her bracelets. A few days later a similar scene occured, but this time the king seems to have made more promises on behalf of Brandon than he was justified in doing, and Margaret consented to leave her ring in his hands, and accept from him a couple in exchange, one of diamond and one of ruby, which he brought next day. Nothing more seems to have passed, and the king and Brandon left for England a day or two after, but later on Margaret hears that reports of her marriage are afloat, and she writes as already mentioned. She describes herself as quite ready to enter into such an arrangement if Brandon wishes it, because she admires him, but she wants to know if he really means business, as he will be in Calais again soon, and she is anxious to know on what footing they are to meet. Henry,

* Cotton MSS., Titus, B. 1, quoted in *Chron. of Calais*, 71.

in order to make him a suitable match for her, raised Brandon to the dukedom of Suffolk, no ordinary honour, for there was at that time only one dukedom extant—that of Buckingham. This kindness on the part of the king recoiled on him, as he could not object to Brandon's want of birth when he subsequently married Mary, Henry's sister, to whom our story now reverts. In 1514, Louis, King of France, lost his wife, and having no issue he at once cast about for a new queen. As at the moment peace existed between England and France, it was not difficult to arrange a treaty of marriage between the two countries, although King Louis was an old *debauché* and Mary a beautiful girl of seventeen. Mary's consent seems to have been taken for granted, but, having a Tudor will of her own, she gave her brother to understand that she was to count for something, and she only consented to the marriage upon condition, that if opportunity occurred, she was to have the disposal of her own hand next time. The opportunity did occur very soon, for Louis died on December 31, 1514, less than three months after the ill-assorted marriage, and Mary was free. As a widow, and known in history as *La Reine Blanche*, Mary lived and kept her little court at the Hotel Cluny. On the 19th January, 1515, Brandon was sent over to Paris as ambassador to arrange the settlement of Mary's dower, and the handsome duke appears soon to have resumed his sway over Mary's heart. Knowing with whom he had to deal, however, Brandon dared not take any steps without the king's consent, for which he wrote, but which did not come. King Francis meantime saw an opportunity of getting rid of the ex-queen, and offered to assist them in a private marriage. Plenty of suitors flocked around, but Mary reminded her royal brother of his promise that she should please herself. The desired permission, however, was withheld. The Tudor blood of Mary was now stirred, and she told Brandon, whose

love-token, an ivy-leaf, symbolical of "Constancy in Love," she is said to have worn next to her heart, in a silver locket, that if he did not marry her within four days, he should never see her face again, so he accepted the help of Francis, and they were privately married in the Hotel Chapel in the early morning, with but few witnesses. It would take too long to describe all the negociations by which Suffolk and Mary obtained Henry's pardon for the dire offence of pleasing themselves; suffice it to say that the Duke and Duchess of Suffolk appear to have lived happily for eighteen years, till Mary's death on June 24, 1533. Though Brandon appears to have been fond of his wife, he was a frugal man, and some allowance should be made for him under the circumstances which we must now relate.

When Katherine of Arragon came over to England to marry, first, Prince Arthur, and, next, his brother Henry, she brought in her train a beautiful girl, Doña Maria de Salazar, who belonged to one of the most illustrious families of Spain.* This lady had captivated the heir of Lord Willoughby d'Eresby, and they were married; unfortunately, the husband died soon after, leaving a widow whose devotion to her royal mistress entitles her to a high place on the roll of noble women. During the disgrace brought upon Katherine by the proceedings for divorce, this lady visited her and supported her by her love and sympathy, and, when she heard that Katherine was on her death bed, she at once mounted her horse, and, mid-winter though it was, with snow on the ground, this daughter of sunny Spain rode to Kimbolton to be with her loved mistress in her last hours. On the way her horse fell and rolled her in the mud, but she gallantly re-mounted and arrived in the dark, very weary. She was asked for her written permit to visit the unfortunate queen, who was at that time treated as a prisoner.

* Du Boys, *Catherine of Arragon*, i., 88.

She evaded this request by saying she must first warm herself and arrange her dress. After resting a little, she demanded to be taken to the queen's bedside, and no one was bold enough to refuse so reasonable a claim at so sad a moment. This was on the 1st January, 1536. She remained at her post till January 7, when the death of Katherine released her from her self-imposed labour of love.

Lord Willoughby had also left one daughter, named Katherine, after the queen. The child was an heiress, and the mother being an alien, she became a ward of the king. Brandon had a son for whom he thought she would make a suitable wife, so he paid the king a large sum, about £2,600, for permission to dispose of the hand of the young lady. Unfortunately, in 1527, the young Lord Lincoln, the handsome son of the beautiful Mary, died of the sweating sickness, and his mother never was happy afterwards. Brandon was thus left with the girl on his hands. To save the money which he had paid for permission to dispose of her hand, the gallant duke within two months of the death of Mary married her himself. The day on which this marriage took place, Sunday, 7th September, 1533, was a notable one in English history, for in the afternoon of the same day, the ill-fated Anne Boleyn gave birth to Elizabeth, afterwards our great queen.*

The curious fatality, upon which we shall have to remark shortly, as occurring in the case of male heirs at this period, followed this marriage, for Katherine's two sons by the Duke of Suffolk, after growing up to be fine young men, and being knighted at the coronation of King Edward VI, died on the same day, in the same bed, of the terrible scourge of those days, the sweating sickness, which had previously carried off their elder brother; this occurred in July, 1551, five years after the death of their father. As the elder brother died

* Friedman's *Anne Boleyn*, i, 229.

first, the younger one, though on his death bed, succeeded to the title, and, dying without a will, gave rise to a curious complication and a very singular legal decision, which became a precedent, and was acted upon for many years, till wiser councils prevailed. On the death of the last duke, his mother, the dowager duchess, claimed the administration of his estates as his next of kin—this was done under an act passed in 21st Henry VIII, by which the administration of intestate estates was granted to the next of kin, the practice up to that date having been that the bishops selected the administrator, on the plea that they were better judges as to who would best employ the deceased's estate for the good of his soul. Frances, the elder daughter of Mary and Brandon, who had now became duchess in her own right, also claimed the administration as his half-sister, and the court came to the singular decision that a mother is not of kin to her son, but a half-sister is, and granted the administration to Frances. This was probably one of the earliest cases decided under the new law, and hence became a precedent.

Katherine retired to Grimsthorpe, the seat of the Willoughbys, in Lincolnshire, where she had for her domestic chaplain, Latimer, afterwards the martyr. Here, apparently soon after the death of her sons, she married Mr. Richard Bertie, son and heir of Thomas Bertie, constable of Hurst Castle. He had been educated by Wriothesley, lord chancellor, at Corpus Christi College, Oxon, where he took his degree as B.A., in 1537.

Soon after this marriage, in 1553, Mary ascended the throne, and evil times began for Protestants, of whom Katherine was one of the most prominent. Taking with them an infant daughter, she escaped to the Continent with her husband, where they underwent much privation as they passed *incognito* through the low countries to find a retreat amongst the Protestant countries in Germany. An old ballad

of the time, published in the reign of Queen Elizabeth, gives the following account of one of their adventures :—

* * * * *

She with her Husband, Nurse, and Child,
In poor Array their Sighs beguil'd.

"Thus thro' *London* they pass'd along,
Each one did take a several Street,
And all along escaping Wrong,
At *Billinsgate* they all did meet,
Like People poor, in *Gravesend* Barge,
They simply went with all their Charge.

* * * * *

"And with a prosp'rous gale of Wind,
In *Flanders* they did safe arrive,
This was to them great Ease of Mind,
And from their Hearts much Woe did drive,
And so with thanks to God on high,
They took their way to *Germany*.

"Thus as they travel'd still disguis'd,
Upon the Highway suddenly,
By cruel Thieves they were surpris'd,
Assaulting their small Company,
And all their Treasure, and their Store,
They took away, and beat them sore.

"The Nurse amidst of all their Fright,
Laid down the child upon the Ground,
She ran away out of their Sight,
And never after that was found,
Then did the Dutchess make great Moan,
With her good Husband all alone.

"The Thieves had then their Horses kill'd,
And all their Money quite had took,
The pretty Baby, almost spoil'd,
Was by the Nurse likewise forsook,
And they far from their Friends did stand,
And succourless in a strange Land.

* * * * *

"Sometimes the Dutchess bore the Child,
As Wet as ever she cou'd be,
And when the lady kind and mild,
Was Weary, then the Child bore He;

And thus they one another eas'd,
And with their Fortunes seem'd well pleas'd.

" And after many a weary Step,
  All Wet-shod both in Dirt and Mire,
After much Grief their Hearts yet leap,
  For Labour doth some Rest require,
A Town before them they did see,
But lodged there they cou'd not be.

" From House to House then they did go,
  Seeking that night where they might lie;
But want of Money was their Woe,
  And still their Babe with Cold did cry;
With Cap and Knee they Court'sy make,
But none of them wou'd Pity take.

" Lo! here a Princess of great Blood.
  Doth pray a Peasant for Relief,
With Tears bedewed as she stood,
  Yet few or none regard her Grief;
Her Speech they cou'd not understand,
But some gave money in her Hand.

" When all in vain her Speech was spent,
  And that they could not House-Room get,
Into a Church-Porch* then they went
  To stand out of the Rain and Wet;
Then said the Dutchess to her Dear,
O that we had some Fire here.

" Then did her Husband so provide,
  That Fire and Coals they got with Speed,
She sat down by the Fire-Side,
  To dress her Daughter that had need;
And while she dressed it in her Lap,
Her Husband made the Infant Pap.

" Anon the Sexton thither came,
  And finding them, there by the Fire,
The drunken Knave all void of Shame,
  To drive them out was his desire,
And spurning out the Noble Dame,
Her Husband's Wrath he did inflame,

* " Of St. *Willebrode*, at *Wesel* in *Germany*, wherein the Dutchess fell in Labour, and was deliver'd of a Son, called *Peregrine*, afterwards Lord *Willoughby* of *Eresby*."—*See* Collins's *Peerage*, &c.

"And all in Fury as he stood,
  He wrung the Church Keys from his Hand,
And struck him so that all the Blood,
  Ran down his head as he did stand;
Wherefore the Sexton presently,
For Aid and Help aloud did cry.

"Then came the Officers in hast,
  And took the Dutchess and her Child,
And with her Husband thus they past,
  Like Lambs beset with Tygers wild;
And to the Governor were brought,
Who understood them not in ought.

"Then Master *Bertie* Brave and Bold,
  In *Latin* made a gallant Speech,
Which all their Mis'ries did unfold,
  And their high Favour did beseech;
With that a Doctor sitting by,
Did know the Dutchess presently.

"And thereupon arising straight,
  With Looks abased at the Sight,
Unto them all that there did wait,
  He thus broke forth in Words aright;
Behold! within your Sight, quoth he,
A Princess of most high Degree!

"With that the Governor, and all the rest
  Were much amaz'd the same to hear!
Who Welcomed this new-come Guest,
  With Rev'rence great, and Princely Chear;
And afterwards convey'd they were,
Unto their Friend Prince *Casimir*.

"A Son she had in *Germany*,
  *Peregrine Bertie* call'd by Name,
Sirnam'd the good Lord *Willoughby*,
  Of Courage great, and worthy Fame;
Her Daughter young, that with her went,
Was afterwards Countess of *Kent*."

The duchess, with Mr. Bertie and their daughter, found an asylum at Wesel, where shortly after a son was born to them, whom, as he was born in their pilgrimage, they named

Peregrine.* On the death of Queen Mary, the family returned to England, and resumed the station to which their rank entitled them. Peregrine was brought up at court, under Cecil, and he seems to have received an education suitable to his position, for when only thirteen years old he wrote a Latin letter to the secretary of state. His mother died when he was twenty-five years old, and he then became Lord Willoughby. It would appear that his father, Richard Bertie, had made a claim to use the title, by courtesy, if not of right; for some letters from the duchess, begging for some such favour, appear in the Hatfield MSS.† This claim was rejected, but Peregrine's claim was at once admitted. In Strype's *Annals* it is stated that the father obtained a decree from the queen granting him the right to use the title, but if he did he never used it. In 1582 Peregrine, Lord Willoughby, was commanded, with the Earl of Leicester, and other principal lords of the country, to accompany the Duke d'Alençon to Flanders on his return from a fruitless effort to obtain the hand of Queen Elizabeth. Thence the queen sent him to Denmark to invest the king of that country with the Order of the Garter. Three years later he went to the Low Countries with Leicester, and was appointed governor of Bergen op Zoom. Here he conducted matters so satisfactorily that, on Leicester's return to England in 1586, he was appointed to succeed him in the command of the English troops in Holland, and, under his leadership, the States of the Netherlands were consolidated, and their independence confirmed. After his return to England in 1588 or 1589 he became, owing to the death of Leicester, head of the military affairs of the country in 1596. We find him entitled, in a letter preserved in the manuscripts of Lord

* *Memoir of Peregrine Bertie*, Lond., 1838, p. 15.

† Hist. MSS. Comm. *Calendar of the MSS. of the Marquis of Salisbury*, Part I, 477, 479, 481.

Leconfield, at Petworth, "the Right Honourable Peregrine Bertye, Knight, Lord Willoughby of Willoughby, Blake and Earsbye, Lord Governor of Her Majesty's Town and Castle of Berwick, and Lord Warden of the Marches anenst Scotland," at which place he died. In 1594 he had been to Spa for his health, to which place the queen wrote him a letter commencing "Good Peregrine. We are not a little glad, that by your journey you have received such good fruit of amendment; especially when we consider what great vexation it is to a mind devoted to actions of honour, to be restrained by any indisposition of body from following those courses to your own reputation, and our great satisfaction, you have formerly performed," and the letter concluded with "your most loving Sovereign, E.R." *

He died, full of honours, in 1601, when only 46 years old, leaving behind him, besides an unspotted military and political record, the still higher name of the good Lord Willoughby. The title continued through his son Peregrine, and their genealogical tree shows that, through their various marriages, they were connected with nearly all the higher aristocracy of England. The family is now represented by the Baroness Willoughby de Eresby, of Grimsthorpe Castle, Lincolnshire.

We must now return to the two daughters of the first duchess—Frances, who became Duchess of Suffolk on the death of her half-brother, and whose history we will presently follow, and Eleanor, who was married to Henry Clifford, Earl of Cumberland, one of whose daughters, Margaret, married Henry Strange, Lord Derby, the progenitor of the noble family residing at Knowsley. Margaret suffered from the jealousy of Elizabeth, for after the death of her cousins she, as representing the House of Suffolk, was on

* David Lloyd's *The Statesmen and Favourites since the Reformation*, p. 349.

pretence of practising magic thrown into the Tower in 1580, where she remained several years, her sole offence being that she, with Mary Queen of Scots, were the next heirs to Elizabeth. Her ultimate fate is not known, but she lived till 1596, and it is believed died in prison.

We will now return to Frances—the elder daughter—who married Henry Grey, Earl of Dorset, who was subsequently raised to the Marquisate, and eventually to the rank and title of his wife, and became Duke of Suffolk. It is curious to remark upon the paucity of *male* children born during these times to the families connected with the royal line, for while Henry VIII, with six wives, had only one son, afterwards Edward VI, neither Mary nor her two daughters left any but female children, and the singular fact exists that at the death of Edward VI, there were twelve or fourteen ladies who might successively claim the throne before a male heir could be found.

Frances, Duchess of Suffolk, was, perhaps not unnaturally, being a niece of the reigning monarch, a proud and haughty dame, and in her intercourse with her family she ruled with a rod of iron, and exacted most abject submission to all her commands. Her youngest daughter, from whose autobiography* we shall have frequent occasion to quote, says her temper was fully as high as her blood. She told her children, when they, poor little things, wanted to have a romp together, or to flatten their noses against the window to see a gay cavalcade, that "always the race of the Tudors should never forget by trifling act or deed the royal stock from which they be sprung;" fortunately, she was much occupied at court, and hence she paid but few visits to the children's quarters, which, says her daughter, "was so much the better, for never did she come but to scold. Woe betided the poor daughter who was in fault; full well was she bobbed and

* *The Tablette booke of Ladye Marye Keyes*, 1604.

thumped, pinched and bumped, and oft times made to eat the verie hardest crust which the kitchen would yield."

Henry Grey and this proud duchess had three daughters, a short sketch of whose lives is our next task.

Of the eldest, Jane, I need scarcely speak, as she formed the subject of the last paper I had the honour to lay before the Society.* Suffice it to say that she was married to Lord Guildford Dudley, son of the Duke of Northumberland, who placed her on the throne on the death of her cousin Edward VI, from whence she was cast down and sent to the Tower. Even then she might have lived happily, but her father-in-law and uncles, mixing themselves up in Wyat's rebellion, indicated clearly to the advisers of Mary that she could not sit securely on her throne while Jane lived to serve as a focus for Protestant intrigue, and she was therefore beheaded, and followed to the scaffold by her father.

The next daughter, Katherine, was beloved by and attached to Lord Hertford, heir to the late Duke of Somerset, the Protector, but political enmity between the families forbade the union, and she was married to Lord Herberte in 1553.

Katherine had been the favourite child of her mother, and was a girl of tender, merry spirit, while her husband was a "haughty, unbending kinde of man whom we could mightilie fear, but never regard with affection;" it is not to wondered at, then, that they did not live happily together, especially when it is borne in mind that Katherine loved another; and eight years after their marriage (1561), a violent quarrel took place, which resulted in their agreeing to a divorce, and Katherine at once secretly married her old lover, the Earl of Hertford. Her new husband had to leave for foreign parts soon after the wedding, but the course of events necessitated the avowal of the marriage, at which Queen

* See Vol. xxxviii, 155.

Elizabeth, who was then on the throne, was very indignant. The Earl returned at once to support his wife by his presence, and they were both sent to the Tower, where their first baby, a bonnie boy, was born in 1562. The Tower was not what we understand by the term prison; it was a small town surrounded by walls, and, though it contained dungeons for use on occasion, many of the so-called prisoners had free use of the whole place, and were quartered upon various officials, with whom they lived, and who were responsible for their safety. So Lord Hertford and Lady Katherine, though residing in different houses, met together frequently, and were visited by their friends; Katherine's younger sister, Mary, often going to play with her little nephew. In 1563, Katherine and her husband were released for awhile to escape a bad fever which raged in the precincts of the Tower, Katherine being entrusted to the care of her uncle, Lord John Grey. In the following year, Katherine gave birth to another son,—an additional offence to the Queen,—for in 1562 a commission had been appointed which, in 1565, declared the marriage between Hertford and Katherine to be unlawful.

Let us now follow the fortunes of the youngest daughter, Mary. She seems to have been almost the drudge of the family, for she was at everyone's beck and call. She says she was small, and not quite straight in her back, but Dan Cupid had found her out. Ten years before, her father used to fish in the Thames, and on one occasion, when so occupied, he heard a splash, and saw a gentleman struggling in the water. He at once swam to him, and saved his life. Mr. Keyes, who was thus rescued, was a gentleman of wealth, but not of noble blood, and a friendship sprung up between the families. Living as he did, near the court, Mr. Keyes succeeded in obtaining the post of serjeant-porter at the palace for his son Martin, who was of noble presence, and

upwards of six feet high. The friendship, which had its origin in the saving of his father's life, continued, but, as he was not noble, of course anything more than friendship was out of the question, though there were frequent conversations between the queen's little maid of honour and the tall sergeant-porter. While Mary was thus occupied with her attendance on the queen, and her practising on the virginalls, and, shall we add, her conversations with the porter, her mother, the proud duchess, now approaching her fiftieth year, found it necessary to take much horse exercise, which had become fashionable, as the queen had caused to be introduced a new saddle, "on which," says Lady Mary, "a body was to sit side-ways." One day, however, the startling news came that the duchess had not returned from her ride, and further enquiry showed that her frequent excursions in the company of her "Master of the Horse" had resulted, as such rides have frequently resulted since, in a marriage between the Tudor duchess and her low-born groom, Adrian Stokes. Poor Mary, well might she say "a bodye might have struck me down with a straw."

Katherine, in the Tower, took the matter a little more philosophically, and chuckled over the fact that "henceforth there will be no more talk of the renowned Tudor race from the lips of our Lady Mother, lest a Tudor ghost should arise, and with his mailed gauntlet, strike her dearly beloved, Master Adrian Stokes, nigh unto death." The duchess soon showed that if she had made a bad choice she would abide by it, for she wrote to Mary and told her of her marriage, and said that, as she preferred seclusion with her dear husband, she should henceforth live at Bradgate. She recommended Mary to follow her example and get married, and she concluded by saying she did not wish her, nor even Katherine, her favourite daughter, to visit her until they could accept Adrian Stokes as their father, with proper reverence and submission. It

was quite anticipated that Elizabeth would have sent the couple to the Tower, but as, singularly enough, she was at the time supposed to have her own eyes fixed upon her "Horsekeeper," the Earl of Leicester, she said little about it, only expressing her astonishment that her aunt should have so demeaned herself. Alas, a very few months were sufficient to unmask the man, who turned out to be a common, ill-bred, "horsey" fellow, who sacrificed everything to his own low and vulgar tastes, broke horses on the lawn, and had the house full of dogs, while his poor wife—erst the proud duchess—was broken in health and spirit. At length Mary was sent for, and she and her aunt Eleanor, the Countess of Cumberland, went down with all speed, only to find the poor duchess lying at the point of death. While they were in her chamber, nearly heartbroken, they heard a great noise in the next room, and soon the door was thrust open by Stokes, who strode in with "good een to you bothe: I hope I see your ladyshippes well; looke at my poore ould woman now, isn't she bad? Beg pardon, ladies, for being covered before ye. But have a good heart, wife, you ain't a-goinge to drop on your race course yet." The duchess motioned him to leave the room,—"What! am I to go? Very well, have your own way, and live the longer," then adding, with a broad grin, "But a year agone things was different; I had no need to be trotted back like a lame horse. It 's very good of your ladyshippes to come so far, so pray make yourselves right welcome—no formes here, all the bodyes do as they like." Soon after he left the room, with an awkward sort of reverence, slammed the door after him, and then they "heard his whistle on the back-stairs, calling to a number of great, huge, uncouth dogs, who barked and whined for many minutes afterwards as never did we hear afore." Mary adds, "Oh, that Master Stokes was an awful creature." The duchess lived only two days longer. Her first husband's

brother, Lord John Grey, came the next day, and gave orders for the funeral after her death, for Stokes had gone for comfort to the brandy bottle, and was, of course, unfit to transact any business. The duchess's maid told Mary that some papers of importance were in the writing cabinet, and they were delighted to find, in a secret drawer, a deed of gift, legally drawn up and witnessed, giving Bradgate, and all its lands, to Lord John Grey, so that Master Stokes had to return to the mire from which he ought never to have been raised.

Let us now return to London. Katherine and her husband, Lord Hertford, are still in the Tower, and Mary is now left to herself. Whilst she is wondering what is to be her course, she was sat one beautiful morning reading Ascham's *School Master*, when she was called into the serving hall to see a messenger from foreign parts. She says, "Fancy a great big burly man, booted and spurred, his thick leather doublet and jerkin all besmeared with mud, and dusty shoes; truly did he look jaded with much travel. 'Lady,' said he, 'pardon the unseemliness of my attire, but I am come express from her Grace the Dowager Marchioness of Dorset, who did herself specifically charge me with this billet to be delivered into no other hands but your ladyship's.'" The marchioness was Mary's grandmother, who, broken hearted at the loss of her husband, her two sons, and her favourite granddaughter, Jane, had retired to France, and had lived there till, nearly eighty years old, she heard of the duchess's folly, when she started for her mansion in the Minories, where she asked Mary to come to her as soon as she could, as she should be there almost as soon as her letter could arrive. Mary gladly took up her abode with the old lady, and we can hope that her attentions were such as to repay the kindness. Her mourning prevented her going out much, but they received visitors at

home, and they made the discovery that all Master Keyes's family were delightful people—the old marchioness was especially struck with the niceness of Master Martin, who seems to have made himself generally agreeable, and often jested with the French companion of the Marchioness. "Sometimes," Mary says "we," that is Mary, her cousins Margaret Clifford and Magdalen Bertie, and Cicely, Martin Keyes's sister, "did spend the best part of the fine afternoons in rambling walks, with only the French maid for chaperone, and cute was she to observe how Master Martin did alwaies pop upon us when leaste could we expect him. 'Ah, Miladi Mary, j'en suis sûr dis handsome Master Keyes il vous adore, what for you blush? He love you, you love him, me tink vraiment que c'est un affair fini.'" "Certain was it" Mary goes on to say, "that mamzelle never speked a truer word, for not many days after, on one of our excursions, somehow was it that me and Martin was left alone. Oh, how well do I remember the narrow lane and the high trees which, arching their boughs above our heads, gently waved in the soft air, the beautiful azure sky peeping through the leaves, the fragrance of the sweet dog roses and whitethorn was so rural and pretty, we did find ourselves sauntering up and down this lane, albeit was we silent for manie minutes, when, oh, how greatly was I astonied, Martin caught my hand, and looking down into my face (for he was so lofty in stature, while poor me was even like a mite in comparison), so did he burst forth a torrent of love speeches—No, if my life was to be tookt can I not recollect what he said, for it was so sudden, all in a moment like." There are many here who can, I dare say, sympathise with this young couple, and scenes like this are not to be made the subject of comment, so I will pass on, and not do as Mary's companions did when this guilty young couple rejoined them, looking, no doubt, very innocent, for they all burst out laughing at them. Mary's

father and mother being dead, she thought she had a right to dispose of her hand, but she was still a more important personage than she thought herself. She tried to take advice from her aunt, but the fear of the queen was before Lady Eleanor, and she said she did not want to know anything, and then she could tell nothing. She kissed Mary, and wished her well, but reminded her of Katherine's fate. Mary took her aunt to mean that she could do as she liked so far as she was concerned, so she determined to tell the old granddam who had been so kind to her, and with whom she lived when not on duty at the palace. The old lady said she could not interfere with matters of that sort at her age, but she added she was really very deaf, and she would be entirely so, and blind besides, if that would help them, and that they could have the services of her French maid. Upon this Mary wrote to Martin, and they arranged that, after a great festivity which was to be given in honour of a royal visitor, they would seize the opportunity afforded them by the excitement, and be secretly married. One reason for taking this opportunity was the fact that all the maids of honour were to have new dresses for the occasion. Mary describes her dress, and she says, "my reader may well imagine that my robe was made with more care, and my vanity may be excused if I say I thought more of that robe than ever I did before." She went to show it to her grandmother, who was not only pleased with it, but suspecting it was intended for a more momentous occasion even than the royal festivity, gave Mary a sandalwood casket, saying she would like to add some ornaments to the pretty robe. The casket contained some strings of pearls, "as big as never was the like." The great day came, and after the queen had retired, about one o'clock, Mary and her cousin, Lady Magdalen Bertie, stole from their room along the darkened passages, leaving behind them a little dog which had been given to Mary by Martin. Martin and his friend met

them, and escorted them to the room allotted to the serjeant-porter, from which came sounds of merriment and laughter. When the door was pushed open, and Mary recovered her sight, dazzled for a moment by the light after their passage through the dark corridors, she was surprised to see the old marchioness seated at the head of the table. After expressions of surprise and delight, the priest was called on to do his work. He was, Mary says, a "little roley poley kind of man," but he married them in due form. After a hasty supper, Mary and Magdalen started back to their room, escorted by Martin and his friend, and while walking as quietly as they could through the darkened passages, their voices were recognised by the little dog who was waiting for them, and he set up such a barking as effectually roused all the people, who came poking their nightcaps out of their doors, and of course saw all these young folks. The gentlemen ran one way and the girls the other, and they *hoped* they would hear no more of it. Early next morning Mary ordered her coach, and set off to take Magdalen home, and then to go to her grandmother's to wait the result of the disturbance. Mary quite expected that she would be called on to explain what she had been about on the previous night. The first news was a letter from Magdalen to say that all was found out, and that some spiteful old maid had told all about it; Martin called soon after, and was invited by the marchioness to make her house his home with Mary, and there they waited to see what course events would take. After a week had elapsed, and no sign had been made, they began to hope the queen had determined to take no notice of them, but then came the fatal order commanding the arrest of "the younger daughter of the late Duke of Suffolk, commonly called the Lady Mary Grey, for her to be forthwith lodged in the Tower, there to await the pleasure of her Majesty the Queen." She was allowed to take her maid

with her, and had tolerable freedom in the Tower, spending much time with her sister and the children, but of course she was strictly prohibited from even seeing her husband. Here for two years she was kept. Lady Lennox was the first of her friends who was released. Then the elder of Katherine's children died, then Katherine herself, then the other child was removed, and Mary was left by herself. At last came the order of release—oh, happy moment! but only a moment, for when the order came to be read, it was found to be merely a change of prison, and ordered her to be taken to Chequers Court, in Buckinghamshire, there to be kept without conference with any one. The Lieutenant of the Tower, however, showed that he had a heart if his queen had none, and in response to Mary's prayers to be allowed to see her husband and her grandmother once again before being sent away, she was told that, if they would be at a certain place, at a specified hour on the following day, he would see whether they could rest there for ten minutes. The meeting took place—the marchioness, Cicely, and Martin being there—and they sat together for a short time in a neighbouring hostel; a sad meeting, for it showed each of them how much the others had suffered. After a short, too short, stay, they parted, and Mary's coach drove on. Arrived at their new place of confinement, Mary and her maid were shocked to find it purely a prison, very different from the comparative freedom they had enjoyed at the Tower. Wretched dungeons, totally unfit, as she says, for a Tudor to inhabit. After a few days she was allowed to walk in the park; the walls were high, and there was no possibility of escape. Some months later they found a closet full of books, which helped to solace them a little, and then Alice, the maid, was allowed to go outside of the park, and one day she found that an old servant of the Greys lived in a neighbouring village, and a "post office" was at once opened for the transmission of letters.

Eventually, when she had been three years at Chequers Court, orders came that Mary was to be sent back to London, and placed in charge of Sir Thomas Gresham—then living in Broad Street—but there to remain without conference with any one, and without liberty to go out. She soon made her preparations, and gladly left the horrible prison. She was received with kindness on her arrival at Sir Thomas's house. Her husband's letters had informed her that he was broken down in health, principally from distress at having caused her so much trouble and anxiety, and she was glad to be so much nearer to him. The kind words of her new host, and his gentle treatment of her, so different from that of her late jailers, who were low and common people, were, she says, as refreshing to her as a hearty meal. Sir Thomas told her he would have a talk with her the next day, after she was rested. She awaited her fate with some anxiety, and was told with great kindness by him that she was allowed to go out with his family, and she could have any of her friends to visit her except,—oh, fatal exception—you and Master Keyes are never to meet. All that affection and care could do to mitigate her troubles the good knight did, and when the old marchioness, with whom Martin had lived since the death of his parents, wanted to come and see Mary, Sir Thomas, who knew that such a visit would annoy the queen, took care nobody was about who was acquainted with the visitor, so that no tales could be told. However, poor Mary, knowing her husband was ill, was not to be comforted, and lived but unhappily for twelve months, when in the spring of 1573 she heard from Alice that Martin was much worse, and could only live but a short time. Mary promptly fell in with a suggestion made by Alice, that she should write to the queen herself. She did so, and showed the letter to Sir Thomas, who not only promised that it should go, but that he would himself write one to accompany it. After some anxious

hours—haunted by dread that no answer, or an unfavourable one, would be returned, or that if a favourable one came it would be too late—the messenger brought a letter written by the queen, giving her permission to visit the house of her grandmother, and a further command that the queen should be daily informed of the state of Martin's health. It is probable that she already knew that her favour had been granted almost too late. Mary flew to her husband's side, but the sight of the change which five years of sickness had wrought in him was too much for her, and she swooned. On her recovery, the doctor told her that her husband's life was ebbing away, and he might die any moment, and urged her to keep up her strength and calmness. The necessity of the occasion nerved her, and she sat at his bedside for some hours while he was in a semi-conscious state. He whispered words feebly in her ear, and his last were, "Kisse me, dear one, I now die happy, on your shoulder, my own loved wife," and then he "calmly passed away with a softe murmur."

The queen now ordered Mary's release, and, her aunt Eleanor having died the previous year, Mary tended her grandmother for about two years, during the greater part of which the old lady was stone blind, till she died. Mary then petitioned the queen that she might have charge of her sister's son, whom she brought up till 1578, when, weary of life, broken hearted, but mocked by kindness from the queen who had so cruelly treated her, she died at the age of about forty years.

On the death of Katherine, her husband, Lord Hertford, was taken into the royal favour again, and we find him appointed to meet and confer with the Earl of Murray respecting the captivity of Mary, Queen of Scots. There is a curious letter from Mary to some one unknown, preserved in the Salisbury MSS. (i. 386.), in which she complains bitterly that two such

people should have any voice in her affairs, for Murray was well known to be inimical to her, and Hertford, having a son by "Dame Katherine," had a direct interest in the death of Mary's son, James. She complains, also, that Elizabeth had promised, in case of the death of James, to have the Earl of Murray, Mary's illegitimate uncle, proclaimed legitimate, and King of Scotland.

Under James I, the Earl of Hertford's son, Lord Beauchamp, succeeded, after a thirty years' fight in the courts of law, in establishing the legality of the marriage of his father with Katherine Grey, which had been declared unlawful by Elizabeth's commission already referred to. Beauchamp died before his father, leaving two sons, the elder of whom died without issue.

His brother, William Seymour, a youth of twenty-three, in 1611, undeterred by the past history of his family, which surely showed the folly of secret and undesirable marriages, was privately united to Arabella Stuart, the cousin of the king. Arabella, who was at that time in her thirty-eighth year, represented Margaret, the elder sister of Henry VIII, while Seymour, as we have seen, was the survivor of the issue of Mary, the younger sister, and the union of these two branches in a secret manner gave great offence to the king. Arabella was at once committed to the Tower, but I cannot learn that her husband was punished, except by the separation. About two years later, Arabella escaped in man's clothing, and actually got on shipboard, but the ship was overhauled by a royal cruiser, and she was captured, and recommitted to the Tower, where she died insane the following year.

Her husband subsequently came into favour at the court of Charles I, married again, was made Marquis of Hertford, and appointed governor to the Prince of Wales; he was subsequently advanced to his great-grandfather's title of Duke

of Somerset, a dignity which he only enjoyed for a few months. He left two grandsons to succeed him, but both died without issue, and the title then passed to a collateral branch, whose fortunes do not come within the scope of this paper.

# SOCRATES AND MODERN THOUGHT.

By Rev. S. FLETCHER WILLIAMS.

In the progress of thought, it is often as important to overthrow as to establish; and the reformers of philosophy, as well as of religion, have all been stern iconoclasts. Emerson has characteristically said:—"Beware when the great God lets loose a thinker on this planet. Then all things are at risk. It is as when a conflagration has broken out in a great city, and no man knows what is safe, or where it will end. There is not a piece of science but its flank may be turned to-morrow; there is not a literary reputation, not the so-called eternal names of fame, that may not be revised and condemned." The names of Aristotle, of Bacon, of Leibnitz, of Kant, may be adduced in illustration of this position; but by none is it so fully illustrated as by Socrates. Each of these great men began his work by a revolt against established authority, and each reached positive conclusions educed by his own method: Socrates instituted a method, but did not build up a doctrine. The one-sidedness of their methods produced provincialisms of science, and by the mixture, in their positive doctrines, of the precious and the vile, gave demonstration of the falsity of the doctrine of Protagoras, that "the individual is the measure of all things;" but Socrates left little positive teaching, and, on this account, his contribution to the world's thought is the most valuable and perfect. The *vis inertiæ* of man is but too well satisfied to receive a theory well wrought out and plausibly presented; and that man renders the greatest service to humanity who comes only as the searcher and trier of these accepted theories, sounding

their depths or shallows, and detecting their inconsistencies, until mind is roused to seek for knowledge more solidly based, and in greater harmony with the laws of thought. If man is, according to the description of Pythagoras, "a hunter of truth"; and if the bracing and development of his intellectual energies by hardy exercise is his highest earthly function, and his surest method of attaining to a clearer vision and a more accurate acquaintance with all that may be known; it is undeniable that a method of enquiry like that instituted by Socrates is the greatest intellectual boon that man can bring to his fellow. To indicate the place of this remarkable man in the higher departments of human affairs is the object of the present paper.

The condition of Athens during his life was such as rendered it desirable that the voice of such a man should be heard in its streets. It had been, from an early period, the most civilised of the Grecian cities. The province of Attica was not remarkable for fertility, but it produced great men. The wise legislation of Solon had laid the foundation of a growing prosperity; and, in the wars with Persia, the Athenians had taken the lead in that grand resistance by which the overwhelming Oriental tide had been rolled back broken to its native shores. The city had been almost ruined; but the princely Cimon, son of Miltiades, the hero of Marathon, and himself a noble leader in war, had taken advantage of the desolation to remodel its form, and to beautify its appearance. His large fortune was liberally bestowed upon this object. Groves were planted, fountains reared, pleasant walks constructed, and the first of the famous porticoes arose by his munificence. To him succeeded the splendid rule of Pericles, who carried out with lavish hand the designs of his predecessor; and although he changed the forms of the government and the administration of justice, injuriously, as I think, to the interests of the citizens, yet, by his patronage

of Phidias, he gave that architectural and sculptural glory to Athens which has raised it above even the envy of the world. Under his administration, the Piræus was united with the city, and a close connection established with its mercantile port, at that time the first in Greece. Morality suffered under the united influence of Pericles and Aspasia; but philosophy deserted its Ionic and Italian homes, to come to the place where genius ruled and dispensed its favours. Literature, previously Hellenic, now became Athenian, and began during this period its glorious reign, and put forth, in one rich season, its most perfect bloom and fruitage. "The father of history" visited Athens, and saw the Propylæa yet uncompleted. Thucydides, an Athenian, was ten years the senior of Socrates. Æschylus,—

> "Athenian Æschylus, Euphorion's son,
> Whose deeds are registered at Marathon,
> Known to the long-haired Medes who met him there,"—

had raised tragedy to a high place. Sophocles and Euripides followed, adding a poetry more refined, and a sentiment more tender. Comedy arose—the sure accompaniment of a corrupt and luxurious refinement—and in that age produced its most perfect examples in the Greek language. The sculptures of Phidias, Callicrates, and Mnesicles, the paintings of Parrhasius, the orations of Lysias and Isocrates, excited and delighted the people. Athens seemed destined to be the home of intellect and beauty. Bathed in its clear and brilliant atmosphere, the pale and monotonous olive glowed with a fresher green; and the colours on the marble were so brought out, blended, and subdued, as to exhibit a richness of tone and softness of harmony not realised elsewhere. Such a region could not fail to inspire all lofty minds; and I do not wonder to find that the intellectual status to which it then attained it still continued to maintain

long after it ceased to be the capital of the first of the Grecian states, and threw the golden chain of its genius over the proud power which vainly fancied that Athens had become its slave.

At the time when Socrates began his mission, the city had become wealthy. The improvements carried on by Pericles gave employment to every workman; commerce was stimulated; and the democratic government which he developed and established gave encouragement to the aspirations of many after political power. The arrangements, too, by which the functions of the Areiopagus had been curtailed, and the duty of administering public justice devolved upon the public, together with the introduction of payment for attending to public affairs—all tended to produce a state of things new to the citizens, and by their requirements gave birth to new desires of acquisition. When six thousand of the inhabitants were annually elected to fill the office of administrators of the public economy, and to preside in judgment, it became a necessity for those who were aspiring to high position to possess the art of winning popular favour by at least the appearance of superior knowledge, and by the power of eloquence. The latter power became necessary also in self-defence, for in the unsettled state of the democracy no man could feel sure of life or liberty. Under the stern rule of the Areiopagus, no attempt at eloquence was permitted to interfere with the solemnity of judicial deliberation; but when an assembly of some hundreds of citizens was intrusted with the powers of jury and of judge, and no professional advocate was allowed to plead, it behoved every man to possess some power of arguing his own cause. Strange methods of moving the judges to mercy were at times adopted, to which Socrates, in the *Apology*, refers—such as bringing a wife and little children to plead by their helplessness. Self-preservation was thus combined

with ambition in making every man seek to be an orator; and according to the universally recognised law of supply and demand, professors of eloquence, of statecraft, and of all other knowledge and art, were produced in abundance. From the fact that many of these men professed almost universal wisdom, they were called Sophists—a word which in its origin had not the sinister meaning which it now universally bears. Yet, even then, it had an undertone of depreciation in it, and Aristotle, not long after, defines it thus:—"The Sophist is one who trades in unreal wisdom." Some of them undertook special departments of knowledge. Gorgias professed rhetoric; Hippias, physical science; but all were charged with professing to teach young men the art of ruling their fellows, and of "making the worse appear the better reason." With such understood pretensions, it is no matter of surprise that their following was numerous and aristocratic, and that wealth flowed in upon them. In a time when there were no libraries, and few books, oral instruction was the only method of communicating knowledge, and the Sophists rose to a height of influence which better men have found it difficult to attain. The account which Plato puts into the mouth of Socrates respecting a visit of the principal Sophists to Athens, enables us easily to conceive the brilliant effect they produced on the minds of their followers.*

Surrounded by the wealthy and accomplished youth of Athens, who came with various purposes—some to learn what might be useful to the right framing of their own lives; most seeking the arts by which they might attain to the dazzling position of Pericles; all longing for a royal road to knowledge and fame—the position of the Sophists was one of peculiar mark and importance, but—notwithstanding Mr. Grote's attempt to make them appear more

* *Protagoras*, c. 15–18.

respectable characters, an attempt not marked by the success which his charity and his chivalry deserve—I cannot look at the specimens of their teaching which have been handed down to us without feeling that they abused their position to the purposes of selfish gain, and to the demoralisation of those who came under their influence. I do not object to their receipt of pay for the instructions they imparted: they had a right to live by their profession, and there never was a time in any state when it was less disreputable than at that time in Athens. But their whole pretensions were unfounded; the tendency of their teaching was to exalt success at the expense of truth; and the principle of Protagoras, to which I have already referred, "that man—the individual—is the measure of all things,"—by which that which appeared to the individual to be truth was truth to him, and that which appeared to another to be truth was truth to him, however contrary the propositions might be to each other,—was a principle destructive of all permanence of truth, leaving no invariable criterion by which it may be ascertained, but exposing it to all the variation of human feeling and passion. Apply the same principle to virtue, and the conduct of mankind must be determined by laws more changeful than the clouds. From such teaching, what but scepticism and immorality could spring?

Through the midst of this Athens, full of indefinite longings after wisdom, and well-defined aspirations after political eminence, and thus amply supplied with professors of every politic art, walked Socrates, with naked feet and old threadbare cloak, talking and questioning. Wherever men, especially young men, were to be found, he was almost sure to be; wherever a Sophist had set up his stall, to exhibit his showy wares for sale to the idle and ambitious, there he appeared in the character of a learner, but in reality as the plague of the pretender.

The form in which he conducted his discussions demands consideration. He never presents himself as a teacher, or as a man having new knowledge to communicate. On the contrary, he uniformly, and even ostentatiously, disclaims such pretensions. He asks questions as having everything to learn. Generally, after a little by-play of talk, he proceeds direct to the object of his enquiry. If the principal is a man of eminence, or very vain, he is usually treated to a small measure of flattery or of banter, in which the comic side of Socrates makes its appearance. If the person with whom he converses boldly answers the question, which is usually the case, Socrates commends him, but has a little doubt; *that* solved, all will be smooth and easy. The attempt is boldly made, only to fix the hapless respondent more thoroughly in the dialectical net which is now gathering round him, until, by successive operations of the same nature, he is hopelessly and helplessly caught. But it is not over yet. Socrates, with an easy grace, and the expression of a hope that he may succeed better next time, releases his unsuspecting prey, and begins the process of questioning again, from a different point of view, perhaps as far away as possible from the point in hand, so that you wonder what he is at, and how he will ever return. The respondent is now more cautious, and answers more guardedly; but all caution is vain when once he has committed himself to a conversation with such a man. Again he falls into a contradiction, and the dialogue comes to a stand-still. Sometimes he grows angry at this point; but the ever-ready Socrates is prepared for this—he was too familiar with it, and he makes a number of propositions, any one of which his antagonist may choose. He himself will submit to be questioned, and perhaps the bait takes; but, quick as thought, he has the question on his side again. No quarter is given. Question follows question, until all that seemed to the respondent to be solid and well-

compacted knowledge melts away. Theories which appeared to dwell in perfect harmony are severed from each other as contradictions, and can never be conjoined again: they stand scowling at each other in irreconcileable opposition, and the man who held them is compelled to plead guilty to inconsistency or to ignorance, or to both.* Whatever the character of the person questioned, the one thing Socrates wishes to ascertain respecting him is, Does he know anything? And the one effect which he wishes to produce in him is a conviction of his ignorance.

In the course of this cross-examining mission, Socrates would be certain to make enemies. It was not easy for statesmen, and orators, and renowned professors, to be meek and mild under the process of being mercilessly pulled to pieces; and, doubtless, if Socrates came among us to-morrow, he would find the human temperament little changed. When men of note came to learn his inveterate habit of questioning everything and everyone, they would rather fight shy of such an impertinent intruder, and wonder where the fellow had learned his manners. Who of us would care to introduce to cultivated society a man who goes round demonstrating to people who think they know something, that they know nothing? Who of us does not believe that his presence would empty our fashionable clubs in a month, if, indeed, he did not before that period suffer an ignominious expulsion? As it was, he often provoked anger; sometimes he received the sharp retort of blows; and every day he was laying up an increased store of wrath to fall on some future occasion on his head.

I cannot altogether justify some points of the process which I have described. The "irony" of Socrates is sometimes such as would test a conscience of any fair measure of

* The purpose and the *modus operandi* of Socrates have been ably and concisely described by Grote, *History of Greece*, vol. viii, p. 285.

tenderness to use. I will not say that Socrates or Plato does not use it a little sophistically; but when we reflect that perhaps their own views were not quite settled, we may hold a more favourable opinion of men making their way toward truth, by the aid of a tentative method, which could not fail in their hands at least to strangle error. No doubt there was much in this process congenial to his nature, which was originally not characterised by tenderness or suavity; but he himself asserts a higher cause of his devotion to a course which involved the abandonment of all the quiet of a well-ordered home, and which made him a servant of the public, without the dignity of being its ruler, or the emoluments of its rewards.*

In studying the process conducted by Socrates, we gain an insight into his method. I have no hesitation in declaring that his method was inductive. Mr. G. H. Lewes, in his brilliant but often misleading *Biographical History of Philosophy*,† has demanded a revision of this opinion, and, with great adroitness, confounding the object-matter of a science with its method, has decided that Socrates must not be regarded as entitled to the praise of having preceded Bacon in that walk. His argument may be reduced to this simple form:—"Bacon pursued physical science, Socrates turned away from it: therefore Socrates did not proceed inductively." Need I stop to point out the fallacy of such an argument? It is true that Mr. Lewes afterwards finds fault with the method *per se*, which he represents as "reasoning by analogy," and illustrates by a foolish argument of Aristippus; but almost immediately he returns upon his old track, by asserting, as the ground of his denial, that the Baconian

* In the *Apology* of Plato, which contains, if not the exact words, yet certainly the sentiments used before his judges, he gives an account of his dedication to this office. *Apol.*, pp. 301–304, c. 5–9.

† Lib. Ed., pp. 127, 128.

induction "is an interrogation of nature"; and therefore, as Socrates turned away from such studies, he could not have followed the inductive method. It seems never to have occurred to Mr. Lewes, as it seems never to occur to some of our eminent naturalists, that physical nature is not the only nature, that physical facts are not the only facts, nor physical laws the only laws; and that mind and morals may be the objects of science pursued inductively, as well as those which furnish the object-matter of physical philosophy. Mr. Lewes, however, may have seen these things treated by others; but being, when he wrote, in his anti-metaphysical stage of positivism, he could not be expected to be very accurate in his estimate of such nonentities as metaphysics or morals.

Happily for my view of the matter, it is confirmed by higher authorities. Bacon himself thus represents his inductive method of procedure, as distinguished from the false method attributed by Mr. Lewes to Socrates—the *inductio per enumerationem simplicem*:—"The induction which proceeds by simple enumeration is puerile, leads to uncertain conclusions, and is exposed to danger from one contradictory instance, deciding generally from too small a number of facts, and those only the most obvious. But a really useful induction for the discovery and demonstration of the arts and sciences should separate nature by proper rejections and exclusions, and then conclude for the affirmative, after collecting a sufficient number of negatives." Then Bacon proceeds to say:—"Now this has not been done, nor even attempted, except perhaps by Plato, who certainly uses this form of induction in some measure to sift definitions and ideas" * Plato certainly advanced his master's method and rendered it more perfect; but in the conversations with Euthydemus, in the *Memorabilia*,† we have all the elements

* *Novum Organum*, Book I, aphorism 105. † Book IV.

of the method as fully as in the most developed dialogue of Plato. Dr. Whewell also assigns to Socrates the same position; and it may be admitted that he possessed a little acquaintance with the Inductive Sciences. And Aristotle, who had some right to speak, says of him:—"Two things are justly ascribed to Socrates—induction, and the definition of universals."* With these testimonies, and inviting your attention to the facts in the extant remains of the Socratic thought, I leave the matter for the present, only remarking that, by claiming for Socrates the merit of being the originator of induction, I do not pluck one leaf from the wreath of Bacon. I accept the dictum of Paley in relation to the adjudication of such crowns:—"He only discovers who proves."

According to the just-cited testimony of Aristotle, we owe to Socrates the definition of universals. With reference to this his inductive inquiries were prosecuted, as he himself informs us, that the conferences which men held were "in order to examine into things, and to distinguish them according to their kinds." † He sought out wherein the peculiar property of things consisted; or, as Aristotle has it, "sought with a rational aim what a thing is." With this view he conversed with men, that he might find out the true character of things, distinguish them according to their nature, classify them, and define them by some common conception. When he came upon the stage he found all things at sea. Previous inquirers, especially those of the Ionic school, had sought the first principle (ἀρχή) of all things, and had given forth their ingenious guesses, which they as ingeniously sustained. Pythagoras had aimed at something higher, and his disciples had attempted, according to Aristotle, a few definitions; but

* "There are two things of which Socrates may justly be regarded as the author, the Inductive Reasoning and Abstract Definitions"—τούς τ' ἐπακτικοὺς λόγους και τὸ ὁρίζεσθαὶ καθόλου (*Metaph.*, xiii, 4).

† *Mem.*, iv, 5, 12.

while some precious truths had been reached by diligent enquiry or happy guess, there was up to this time no *organon* of the sciences, and, strictly speaking, no science at all. The Sophists had produced a singular jumble of unrelated things, drawn from very different regions of the universe, and, with the impudence which attends pretension, had professed the power of answering all questions, teaching all sciences, and overthrowing all conclusions. To discriminate things that differed, and to unite those which agreed under a common and fixed definition, appeared to Socrates all important, and he pursued that end. Not that he seemed much to care for the synthetic upbuilding of dogmatic truth, or of systematic philosophy; *that* was sure to come, and to come right, too, he believed, when men had their minds freed from error, and had become thinkers. To lay the axe, therefore, at the root of the tree, with the sturdy blow of a genuine backwoods clearer, was his aim, his duty, his delight; good could scarcely fail to spring up in the thoroughly cleared soil when the seed of right thought fell into fitly prepared places.*

* It may be said that Socrates, professing from the beginning to have no positive theory to support, maintains to the end the air of a learner, who would be glad to solve the difficulty if he could, but regrets to find himself disappointed of that instruction which was promised. Yet all the while the whole tenour of his questions, seemingly only negative, has all along been such as to suggest, and often even to imply, a distinctly positive teaching, and so to cause the truth to creep into the mind without offensive dogmatism on his part, and with the pleasant though fictitious feeling on the part of his hearers that they had thought out the truth for themselves. Without distinctly asserting his own opinion, and even while professing to have none, Socrates manages to make his audience embrace with favour and with fervour the just and inevitable conclusions to which the discussion leads or tends. Through continuous exclusion of the wrong, a knowledge of the right is gained. As fallacy after fallacy fails and falls before the strong practical intellect which directs its energies against them, and as they are thrust by the onlookers into the limbo of the extravagant, the ludicrous, the sophistic, the irredeemably false, the eye turns upon that which is undemolished and unhit, and sees that *that* alone is unassailed, and is evidently unassailed because it is impregnable.

What positive teaching did Socrates give to the world? In answering this question, I think we may parallel the intellectual conditions of our own day with those that existed in the time of Socrates, not in an exact and a detailed way, but in a general way. The questions which had interested the thinkers among the Greeks before Socrates were, in general, of a scientific nature. There was certainly some difference in spirit and method from our own scientific men, else I should imagine they would have reached some more positive and definite results. But they were concerned about the same objects, the material elements and forces, the heavenly bodies, life, and the *Kosmos*, and sought, under the impulse of the same cravings that we have, for an explanation or theory of things. Xenophon says it was about "the nature of things" that "most other philosophers disputed, speculating how that which is called, by sophists, the universe, κοσμός, is constituted, and by what necessary laws everything in the heavens is effected." * . . . But Socrates "first of all inquired whether such persons thought they had so far mastered the facts which relate to man as to be justified in proceeding to such investigations, or whether they considered it in order to leave human inquiries for physical researches."

Now in regard to the nature of things, or the constitution of the Kosmos, Socrates was a good deal of an agnostic. He did not know much about it, and, moreover, did not think anyone knew, and herein explained the utterance of the oracle about his wisdom, not that he knew, but that he knew the limits of his knowledge. Those limits, too, were not self-imposed, but from a higher appointment; and he did not believe "that those acted dutifully towards the gods who inquired into things which they did not wish to make known." And we may imagine that it was with a touch of humour that he warned those anxious about such investiga-

* *Mem.*, i, 1, 2. † *Mem.*, iv, 7, 6.

tions that they might lose their senses like Anaxagoras, "who prided himself on explaining the plans of the gods." He threw his whole strength into inquiries, ethical, political, and religious.* And this not from mere lack of curiosity, or of the scientific impulse. He had a positive interest in other matters, and it was because these were so prominently before his mind that the ordinary inquiries of philosophers lost their interest to him. The practical impulses prevailed in him over the scientific. The scientific student, pure and simple, cares nothing for practical uses: to know the facts is enough. He perhaps best learns the facts by entirely "immersing himself" (to use a Hegelian phrase), and forgetting that he has any personal interests, or that there are any uses which his knowledge might serve. But whatever may be the worth or the dignity of this spirit—and I think it a noble spirit, for the love of knowledge for its own sake is philosophy, while the love of knowledge for its uses, for its gains, for the sake of turning it to account, is something widely different, and is apt to lead quite otherwhere than to truth—still, Socrates was possessed by another spirit. His object was not to find out things as they are, but to *make things better*. Can man improve nature? He can, at any rate, improve himself, and men about him, and can summon and use his and their powers for noble ends. It was this practical and moral impulse which moved Socrates, and which became so strong, so much of a passion and a necessity, that he felt it was a divine power working through him, giving him a sacred trust and mission. Cicero distinctly recognises this change in philosophy which Socrates made when, in his well-known passage, he says:—"Calling down philosophy from the heavens he placed her in cities, introduced her into private families, and compelled men to inquire

* The field of investigation in which Socrates employed his method is designated by Aristotle as the ethical (*Metaph.*, i, 6).

concerning human life, morals, and things good and evil." * "For himself," as Xenophon tells us, "he would hold discourse," not on the origin of things, or on the laws of nature, but "on what concerned mankind, considering what was pious or what impious; what was honourable, what base; what was just, what unjust; what was wisdom, what folly; what was courage, what cowardice; what a state was, and what the character of a statesman; what was the nature of government over men, and what the qualifications for such government." † These testimonies leave us in no doubt as to the character of the discourse of Socrates. They are sufficient for those who have not studied the works of his disciples; those who have attended to them do not need any.

The interest of many thinkers to-day centres in scientific questions. Is matter the ultimate reality? Are all things governed by necessary laws? Is life anything more than complicated mechanism? Are thought and feeling functions of the brain? Is there design in nature, or only unintelligent necessity? A true theory on all these questions is, indeed, a desirable theory, and we need not be as agnostic as to despair of attaining it. But is it the first and the most fundamental object of interest? I do not think that anyone in this society will charge me with a want of allegiance to the questions of modern science. I confess to a passionate devotion to them, and to an earnest labouring after an understanding of life, of the soul, of the physical and psychical constitution of man; but I put in a plea that we should ask, first and foremost, in the spirit of Socrates, "what is just, and what unjust," and that we should scan our present social and industrial conditions to see where "the just" ought to be, and where "the unjust" is. Physical studies, like the sentiments of religion, shape themselves differently to different minds; and to me

* *Tusc Disputat*, v, 4, 10. † *Mem.*, i, 16.

there is nothing comprehended within the terms "knowledge of nature" which has not about it something elevating to the human spirit. But I plead that we find the highest, the divine, not without, in fair scenes or nature, nor in the actual state of human society, but in the idea we have of *what ought to be*, and in the strong impulsion that makes us work for its realisation. To one who feels in this way, there are subjects even more important than the nature of life or the origin of man. An ingenuous person will, indeed, be ready and eager for any light on these subjects, and will be predisposed to accept the results of the investigations of such free and patient and laborious students as modern science counts among its representatives. But it will be other studies than scientific that will particularly engage him, and none of his study will be done with a purely or an exclusively scientific interest, but always with a final aim of bettering and elevating his fellowmen. *Political Economy* will be one of his first studies, for thereby he learns the real fundamental nature of human society, not the dates and events and personages of history, but the underlying forces which have given, in their varied play and manifestation, the significance to most events and personages. He sees that men are not primarily seekers after truth or lovers of duty, which one would suppose them to be from many treatises on philosophy, and from most sermons, but that they are toilers for their "daily bread," and much of life and duty and truth has to do with just this toil and struggle; that life is being successful in it; that justice is in each man's having the honest results of his struggle, and that the most pressing "truth" is that which, being learned, makes the struggle less, and leaves man a chance for other employments. *Political Science* will be another study, for it treats first of the inquiries of Socrates, "what a state is, what the character of a statesman, what the nature of government." He

who has no well grounded theory of government is not in a position to judge one way or another of the Socialistic phenomena already so prominent on the continent of Europe, and destined to become more and more so in our own country. Here is included, too, the theory, historically, at the foundation of our own constitution, and the development and changes that have taken place in our constitutional history. All that is included under the term *Social Science* is of immediate importance; and imperious is its urgency upon those who maintain that the individual and society are the results of the influences of heredity, commingled with the influences of surrounding circumstances, for if they are the results of certain causes in the past, they are also new causes for the future, and by changing the circumstances and conditions, by creating new combinations and new motives, the nature of men will be in the end effectually modified, and society ennobled. All this I plead for, and science too! There is no inconsistency. There is no antagonism. At least there need be none. We can dispense with nothing in this work of ours—to fashion a more perfect manhood, a completer womanhood.

In his ethical teaching, Socrates, says Aristotle, searched for the universal, and was the first to apply his understanding to the subject of definitions. In accordance with this object we find him asking, "Are the virtues different from virtue? Are they parts of virtue—parts homogeneous or diverse?" ever seeking after some fixed standard of virtue, some "common notion," some universal definition. Sometimes he finds it in knowledge, or science, or wisdom; * sometimes he seems to find it in utility, or at least in coincidence with utility.

Out of the former of these theories arises one of the most serious errors of the Socratic system—the doctrine that "no

* He identifies also σοφία and ἐπιστήμη (*Mem.*, iv, 6).

man willingly acts wickedly," that a man does what he knows he ought to do, and does not do what he knows he ought not to do.* It is a pervasive principle of the Socratic ethics that all virtue is resolvable into knowledge, all vice into ignorance; that no man ever does wrong wilfully—only as the result of ignorance; and the proper remedy to apply is enlarged teaching of consequences. Now, as Mr. Grote justly observes, this is a commanding portion of ethics, but not the whole. Certainly, men can never properly secure happiness without a knowledge of the conditions on which it depends, and such knowledge is an indispensable preliminary; but beyond that there is another province, for, besides knowing what is right, we must possess the passion to do it,† and this necessitates a training of the emotions, of the moral sense, of conscience, of the will—in other words, moral education—as well as instruction of the intellect; so that thought and feeling may work in harmony for the attainment of the highest good.

The principle of the Socratic ethics is not dead. In our own day, there are those who write and speak as if moral conduct and character were included within general and particular moral intelligence. Like Socrates, they resolve all evil-doing into ignorance. If men knew what they ought to do, they would do it. Alas! I fear that every man of us carries, each in his own breast, the refutation of this theory. For what man is there of us whose action steps in perfect time with his idea of right? What think you? If the moral judgments of the world should remain for this whole year exactly as they are now, only at every point they should be embodied in men's actions, would there be no change for

* Xen., *Mem.*, iii, 9; iv, 6. Cf. *Sympos.*, ii, 12; Plato, *Apol.*, 25e; *Protag.*, c. 103, 104.

† Xenophon seems to regard more than teaching as necessary to the production of virtue, and mentions practice or exercise (ἀσκητόν—*Mem.*, i, 2, 19) as among the means resorted to.

the better in the world's morality? There would be such a change that we should doubt either our personal identity or the identity of the world in which we live. Intelligence does indeed promote the cause of righteousness. But intelligence is effect as well as cause, and one potent cause of it, in the moral sphere, is obedience to the moral law. "'Tis goodwill makes intelligence," sings Emerson. And in another place he says, "If a man's eye is on the Eternal, his intellect will grow." So the remedy for wrong-doing is not only more knowledge, as Socrates taught, but a diviner ethical impulse—the culture not only of human thought, but also of human will and feeling; and, in connection with this, it is worthy of note that Mr. Herbert Spencer admits that feeling is far vaster than thought, and is the real controller of human destiny.

With respect to the connection in the mind of Socrates between Ethics and Theology, I cannot agree with Professor Bain that it was "very slender."* It is clear enough he believed in a most unquestionable ethical authority, somehow or other established in man's constitution. He regarded man as framed in the very structure of his constitution into a moral system. He found himself amenable to a law which was not the product of his will, but which was irrevocably imposed upon him as supreme for all his choices. All this testified, with him, to the existence of a Lawgiver, writing the high imperatives to righteousness and duty in man's inmost nature.†

* *Mental and Moral Philosophy*, p. 462.

† The immediate conviction of the suitableness or unsuitableness of certain actions, of whose origin he was not conscious, but which he recognised as a sign pointing him to the right way, he piously ascribed, without subjecting it to psychological analysis, to divine agency. This divine leading is that which he designates as his δαιμόνιον, or rather he uses the terms, τὸ δαιμόνιον, or δαιμόνιον τι, or θεῖόν τι καὶ δαιμόνιον, "a divine or supernatural somewhat." In the *Apology* of Plato, as already mentioned, Socrates says, "The reason of my remaining apart from public life

Socrates believed that there was this moral authority compassing our lives and action. No man sees it, or hears it; it is not a definite, tangible thing; but nevertheless, at every step in a man's life where there is a right and a wrong, there is a *must* on the one side, and a *must not* on the other. To most men, this seems figurative language, but to a few, and Socrates was one of the few, it answers to their most real experience; not surer is the sky, or the earth, or the voice of a friend, than this moral authority known to the secret heart. With this moral consciousness he felt that he was related to another order than the physical. Because he saw it, and became conscious of it, he was related to it, and had a part in it, and must stand in this part, and witness for it. He says, "Wherever anyone either stations himself because he thinks it right to be there, or is stationed by

is ὅτι μοι θεῖόν τι καὶ δαιμόνιον γίγνεται," and he goes on to explain that, from his youth up, he had ever been cognisant of a voice, which only warned, but never encouraged him. This voice he terms, in the *Phædrus*, "his demonic and familiar sign" (τὸ δαιμόνιόν τε καὶ τὸ εἰωθὸς σημεῖον). According to Xenophon, *Mem.*, iv, 8, 5, this δαιμόνιον interposed its warning when he was about to reflect on the defence he should make before his judges, *i.e.*, his practical tact shewed him that it was worthier of him, and better for his cause, that he should give himself exclusively over to the solemn inspiration of the moment, than by rhetorical preparation to prejudice his hopes of such inspiration. Less exact is the occasional statement of Xenophon, that Socrates was shewn by the δαιμόνιον "what things he ought to do and what not" (ἅ τε χρὴ ποιεῖν καὶ ἃ μή, *Mem.*, i, 4, 15; iv, 3, 12). The power from which this voice emanated is designated, as I have said, as "the God" (ὁ θεός, *Mem.*, iv, 8, 6), or "the Gods" (οἱ θεοί, *Mem.*, i, 4, 15; iv, 3, 12),—the same Gods who speak to men by the oracles?

What are we to think of this δαιμόνιον? It has greatly puzzled modern inquirers; but we may comprehend it when we realise his extraordinary faculty of judgment, which so unerringly, intuitively, almost even instinctively, led him to apprehend and know results from an acquaintance with their antecedents—which gave to him almost the power to prophesy, always the capacity to decide and determine—which he had learned to look upon as his unfailing help in argument, and his infallible guide in life. When he looked abroad upon the flighty, unsettled, fickle Athenians, "tossed about with every wind of doctrine," and veering continually as the tenour of a discourse changed; when he conversed with the reputed wisdom-

his commander, there, I think, ought he to remain, and face danger, taking into account neither death nor anything else in comparison with disgrace." It was not by any outward commander that Socrates was placed in his work, and told to stand there, but as little was it by his own arbitrary will and pleasure; he was there because he felt it was *right* to be there; he stayed and stood because the right held him by its divine attractiveness, because he felt linked thereby to an Order and a Power higher than himself. He did not, perhaps, believe in the gods of the Greek religion as far as they were deifications of natural objects; but on the basis of this ethical consciousness, and interpreting it as linking him to somewhat real and objective, he declared that he believed in God as did not one of his accusers. To him, the law of duty in the ethical perception, the imperative to right, came from a source back of itself, binding human freedom to righteousness. The law,

mongers of his day, and found them each opposing the other, and yet unable to give him explicit and unequivocal grounds for the belief they strove to inculcate on the minds of men; when he saw worships, politics, parties changing to suit the changing fashions of the time, and yet felt within himself a spirit of fixed and firm-built faith—an instantaneous decisiveness of thought, a resolutely unswerving method of life—what could he fancy but that there was in him a something, an agency, a spirit, which was not equally operant in other men? The very earnestness and force of his imagination, the very power and intensity of his intellect, would give to him at some moments a feeling of inspiration; and in the supreme hours of thought he would fancy that a Divine Teacher whispered to his soul; that a wisdom higher than man's spoke in his thoughts; and that his genius really taught him to distinguish false from true. What if this virtuous man felt himself a teacher come from God, and laid claim to divine guidance, and a divine mission? Why should we think a Greek unworthy of what was vouchsafed to a Hebrew? If the word of the Lord came to Amos "among the herdsmen of Tekoa," why should the humble shop of a sculptor be unvisited, when a preacher of righteousness was to be raised up, whose voice should recall men to the path they had wandered from? The acuteness, the common sense, the integrity, so rich and strong in the character of Socrates, are an abundant answer to the charge that he was either an enthusiast or a deceiver. If, therefore, he claimed a divine mission, he did it on grounds as good and solid as those of any Hebrew prophet; and who will say that he was unworthy to have received it?

therefore, necessarily pointed back to the creative power that, as Lawgiver, had wrought it into man's constitution, and evermore revealed through it His existence and sovereignty; and, in this light, the law itself was not less, but greater and higher, than any natural object, or even than the sum of them.

It is not within the scope of this Paper to state and consider the political and religious views of Socrates; and I therefore proceed to say that, after all, the actual teaching of Socrates, in ethics, or politics, or theology, is not so valuable as that dialectical method which he perfected and bequeathed. What constitutes an epoch in philosophy? *A method.* "A method," says Lewes, "was his all in all. . . Previous philosophers had shewn the futility of speculation; certitude was nowhere to be had; all theories were but the conceit of knowledge. The method which he taught was that by which alone man could become wiser and better." * It was a method which probes into and analyses every argument and dissects every term, which dispels that mist or illusion of wisdom wherein the mind is wrapped up, which resolutely rejects all fancied knowledge, and compels every asserted truth to make good its claim on human credence. To the logician and the seeker after truth it is invaluable, being a direct appeal to experience and the test of verification. He did not teach it explicitly; but it is evident, both from the sameness of the course adopted by him in all his conversations, and from the genuine impression made upon his pupils that science—knowledge—is the result of a process not so much of *education* as of *eduction;* it was not taught, it was drawn out. Even when ignorant of the peculiarities and processes of his method, they were never at a loss to comprehend the special aim he steadily kept before him, namely, to make each man capable of thinking

* *Biog. His. of Philosophy*, Lib. Ed., p. 184.

for himself. He sought by controversy to excite the mind to thought, in perfect confidence that, if it worked honestly, it would attain to truth, or something near it. Socraticism was, in fact, a cross-examining controversialism, a turning of thought against thought, "not to contradict nor to believe, but to weigh and to consider." His style of thought was a realisation of the Miltonic maxim, "Let truth and falsehood grapple. Who ever knew truth to be worsted in a fair and open encounter?"

Having endeavoured, however ineffectively, to indicate the place of Socrates among the thinkers of ancient, and indeed of all times, I may now express my entire agreement with the estimate of Mitford:—

"The singular merit of Socrates lay in the purity and usefulness of his manners and conversation; the clearness with which he saw, and the steadiness with which he practised, in a blind and corrupt age, all moral duties; the disinterestedness and the zeal with which he devoted himself to the benefit of others; and the enlarged and warm benevolence: whence his supreme and only pleasure seems to have consisted in doing good. The purity of Christian morality—little enough, indeed, seen in practice—nevertheless is become so familiar in theory, that it passes almost for obvious, and even congenial to the human mind. Those only will justify the merit of that near approach to it which Socrates made, who will take the pains to gather, as they may, from the writings of his contemporaries and predecessors, how little conception of it was entertained before his time; how dull to a just moral sense the human mind has really been; how slow the progress in the investigation of the moral duties, even where not only great pains have been taken, but the greatest abilities zealously employed; and when discovered, how difficult it has been to establish them by proofs beyond controversy, or proofs even that would be generally admitted by the reason of men. It is through the light diffused by his doctrine, enforced by his practice, with the advantage of having both the doctrine and practice exhibited to the highest advantage in the incomparable writings of disciples such as Xenophon and Plato, that his life forms an era in the history of Athens and of men."

## NOTES ON TWO PAPYRI AT BOULAK.

By B. L. BENAS.

The discussion which followed the admirable paper of the Rev. Fletcher Williams, at our last meeting, suggested the following reflections upon two papyri preserved in the Khedivial Museum at Boulak, near Cairo, and translated into French by Professor Maspero. The learned curator is the successor of Mariette Bey, and one of the most eminent living Egyptologists. When I visited the museum, in the early part of last year, I had the privilege of a lengthened interview with this distinguished *savant*, who indicated some of the priceless treasures which have been placed under his charge.

It occurred to me that the drift of the discussion, after the paper on Socrates, tended to the assumption that the Socratean and Platonic school of ethics was the first that gave a clear and unmistakeable expression to the theory of an after life. The Egyptians' claims, though tinged with anthropomorphism, seemed to have been singularly overlooked. Now, we have the record of a remarkable document, found in an almost perfect state of preservation. It is a "Scroll of the Dead," found in the sarcophagus of Senhotpou, an Egyptian of high social position, living during the period of the XX dynasty. It is, perhaps, unique of its kind. The scroll contains 125 chapters, minutely detailing every incident in the life of the interred. No similar relic, of so remote a period in Egyptian history, has ever been forthcoming. Of course, there have been inscriptions and monuments found and deciphered, of a still earlier period, but

nothing so voluminous and so complete as this scroll. It was found in the district of Sheikh Abd el Gournah. Now the period of the XX dynasty is all the more interesting as it represents a cycle of the greatest obscurity in Egyptian history, and Manetho, the Egyptian priest, who writes some thousand years later, confesses that little is known of that period. It is even difficult to fix the exact corresponding date, except by analogous history. We know that one of the twenty-second dynasty was Shishak, who gave Jeroboam refuge during the reign of King Solomon. We know that the principal Egyptologists place the exodus under Rameses, who was of the eighteenth dynasty. We could thus venture to fix the date of this scroll of papyrus at about contemporary with Joshua, or the early Judges. According to Egyptian custom, all persons after death had to submit to the judgment of a tribunal, who decreed oblivion or immortality. The wealthy and governing classes had their records carefully written for them; this was placed in their sarcophagus. According to Professor Maspero, "Le livre des morts est donc une sorte de Guide que tout Egyptien devait avoir avec lui pour voyager en sureté dans l'autre monde. Aussi on mettait un des exemplaires plus ou moins complets sur toutes les momies de bonne famille."

It seems that, for the lower and ignorant castes, and the poor, there was a kind of fixed liturgy, which it was the duty of the living to commit to memory, for repetition in the next world by the deceased, and this liturgy was recited by the next of kin, or best friend, before a tribunal, who gave their final verdict according to the evidence and cross-examination, rather than the *ipsissima verba* of the liturgy, which appears to have been a perfunctory proceeding so far as the humbler classes were concerned.

Chapter cxxv in this scroll brings the defunct up to the period of his final judgment, and commences with a pictorial

illustration of Osiris seated upon a throne. Behind him is depicted the infernal jury, charged with the deliberation of the act of justice to be decided upon. A pair of scales is placed in the foreground; in the one is contained the heart of the deceased, and in the other his effigy. A twin representation of "Truth" introduces the departed, and assists at the weighing, whilst the deity Hor flits at the head of the beam, mercifully inclining it somewhat to the favourable side. The deity Tot is depicted writing the result, and proclaiming judgment. The deceased then proceeds to plead for himself in the following words:—

Homage to ye, Lords of Truth. Homage to thee, great God—Lord of "all Truth." I come to bring "Truth" before ye, and before ye I destroy all falsehood.

I have never defrauded any human being.

I have never grieved the widow.

I have never lied in a court of Justice.

Falsehood has ever been a stranger to me.

I have endeavoured to do nothing forbidden.

I have not imposed upon a clerk of the works more daily or periodical labour than I contracted with him.

I have never been negligent.

I have never been lazy.

I have never weakened my natural forces.

I have never been bankrupt.

I have never depreciated a slave before his master.

I have allowed no one to hunger.

I have caused no one to shed tears.

I have never killed.

Nor have I ever caused murder to be committed treasonably.

I have never participated in fraudulent gains.

I have never altered a measure.

I have never taken an inch from a yard measure.

I have never encroached upon a neighbouring field.

I have never disturbed the equilibrium of scales.

I have never attempted to gain by false weights.

I have never taken away the milk from the mouth of those who suck.

Here follows the expression, thrice repeated :—

"I am pure"—"I am pure"—"I am pure."

Further on, the deceased repeats, in an affirmative manner, the negative confession he has previously uttered—thus :—

Deliver me from Tryphon, who feeds on entrails. O ye magistrates in this day of supreme judgment—permit the defunct to come to you, he who has never sinned, who has never lied, never done evil, never committed a crime, never rendered false witness, never inflicted any wrong to his own body, but lived by righteousness. He has sown everywhere the seeds of gladness. All his actions were such that men spoke of it, and the gods rejoiced at it. He has reconciled God unto himself by his love for him. He has given bread to the hungry, water to the thirsty, raiment to the naked.

He has given a bark to the shipwrecked who were stopped in their voyage. He has offered sacrifices to the gods, and funeral repasts for the defunct. Deliver him from himself. Protect him from himself. Do not speak against him before the Lord of the dead, for his mouth is pure, and his two hands are pure.

The verdict of the tribunal is likewise appended. The soul is acquitted, and for complete purification is transferred to four cynocephali, who are to be plunged into a basin of fire. The soul would then, refined from every scintilla of impurity, go to the realms of endless bliss.

It is a pity we have no record left of the verdict of an Egyptian tribunal upon one of the humbler castes, or of those who may not have been wealthy or occupied so high a social position. The ethics of so remote a period in Egyptian history are dimly foreshadowed in this document, which I hope to elaborate in a future paper. We see that, in the constitution of the early society in the land of the Nile, a period of rest from labour, for the workman, was also a part of their social system.

Another valuable papyrus, which Professor Maspero describes as "l'un des plus curieux que l'on connaisse," is

unfortunately in a very dilapidated condition, as is the case with almost every example that has yet been found of the remote periods. With the exception of the former scroll, not a single one has ever been handed to us in anything like a moderately preserved state. The commencement of this document is altogether missing, and as the first few rolls were unfolded, the papyrus broke into tiny shreds. What is left of it has been carefully deciphered. It is of the early XXII dynasty, a period coincident with the latter days of Saul, or early Davidic kingdom. It is a treatise on morals, in the form of a dialogue between a learned scribe, Ani, and his son, Khonshotpou. Here and there a paragraph is legible, and seems to indicate practical precepts for conduct through life. Here is one :—

Beware of the strange woman, who is not acknowledged in her own city. Do not run after women like unto her. Do not attempt to know her, for it is a deep sea in which no man finds his way out The woman who separates herself from her husband sends thee written messages every day. If no witnesses are there, she comes herself to seduce thee into her net If the world gets to know of this, it will be a fatal crime for thee, even if she has not succeeded in reality. For men commit all sorts of crime for such as these.

Here we find another legible extract :—

Do not get drunk in the public houses where they drink beer, for fear that people may repeat words uttered from thy lips, without having the knowledge that thou hast even spoken them. Thou will'st stumble, thy limbs will be broken, and no one will extend a hand to help thee; on the contrary, thy companions in drink (or boon companions) who are there, will even say, "Turn the Drunkard out." They will send from home to look for thee concerning thy business, but they will find thee crawling on the ground like a little baby.

In another portion, we read :—

I, Ani, have given thee thy mother, but she, whilst she bore thee, as she did bear thee, had with thee a most painful load, of which she

did not even complain to me. After thy birth she gave thee suck for three years, and as thou didst grow, although thy swaddling clothes were sullied, she never turned from thee with disgust, nor asked thee, Why doest thou thus?

When thou hadst been placed in school, and though thou wert instructed in letters, she went perpetually to and fro to the house of thy instructor; every day she brought thee bread and beer from her house. Now thou art grown to man's estate, and hast taken thee a wife, thou hast mounted thyself into an apartment. Have always an eye upon the wearisome times which accompanied thy birth, so that all thine actions may be regulated by the example of thy mother, and what she did for thee, so that she may never have to reproach thee, that she lift not her hands towards God—for verily God will hearken to her prayers.

There are some fairly well preserved pages, indicating how one should regulate their conduct towards their superiors, towards the dead, on friendship, etc., and Professor Maspero points out that in several places he finds Egyptian local sayings, maxims, or proverbs, identical with those in France. For instance, in this papyrus we find the following:—

Sans se presser pour arriver le bon marcheur arrive.

The man who walks well arrives without hurry.

And again:—

Le bœuf qui marche en tete du troupeau et qui mène les autres aux champs, n'est lui même qu'un animal comme eux.

The bull that walks at the head of the herd, and leads the others to the field, is only a beast like the rest.

The papyrus at the end of the dialogue is fairly well preserved.

Konshotpou is described as replying to his father thus:—

Do not wearisomely repeat thy past favours towards me! I have heard enough of all thou hast done.

Ani responds:—

Here I see a true reflection of all those who have found out the strength of their arms. The suckling, who is in the arms of his mother, has no desire for any food but that which proceeds from the breast The moment his tongue has found speech, it is only to say, "Bring me bread."

Professor Maspero expresses an opinion that until now we have only touched the fringe of our knowledge of Egyptian polity and ethics. He is now engaged in excavations in certain districts along the Nile which have been undisturbed for remote ages, and is sanguine that we shall eventually add very much to our limited knowledge of the theology, statecraft, and early civilisation of this interesting and historic country.

I hope at a future time to recur to the subject of Ancient Egypt, but I am of opinion that, in deductions from Palestinian and Hellenic ethics, too little stress is laid upon the copious draughts which both races have imbibed from Egyptian sources.

A saying is attributed to Prince Talleyrand, that the French have admirable laws, but observe them badly, whilst the English had defective laws but observed them admirably. I venture to think that the position in civilisation a community occupies is due less to its being in possession of high ideal ethics, than to how far these ethics are carried into practical life. For instance, the ethics of the Abyssinians are drawn from the same sources as our own, yet in their social status and general civilisation they have remained rather below that of their neighbours. The Copts in Egypt are neither as temperate nor as frugal as the Arab fellaheen, and the descendants of European denizens in the East, known as Levantines, who are superstitiously attached to the outward forms and ceremonies of the Church, would not be held as exemplary specimens of the higher followers of

Western ethical culture, whilst the Bulgarians and Servians, who have only just emerged into emancipation from the depressing sway of centuries of contumely, into the light and freedom of the highest ethical ideals, fly at each others' throats, hardly better than two rival tribes of Red Indians.

Climate, I further venture to think, has a powerful influence in the tendency of the social and moral habits of the people. One dare hardly venture to speculate as to whether the Scotch or Dutch people would have developed the remarkable energy and the great mental vigour they undoubtedly possess, had it been their destiny to be located, say, in Tripoli, or in the upper districts of the Nile.

That the Mizraim of old had a large measure of civilisation and ethical culture among the higher castes, is proved beyond a doubt. The exiled shepherds, who were divinely emancipated from Egypt, seem to have reversed the Mizraimic policy, and made the study of such ethics as they became possessed of, the property of the multitude, rather than the few, for in their records we constantly find the injunction, and "ye shall teach the law to your children," and that it should be read unto the people, and as their ethics gradually evolved by contact with other modes of thought, they were adopted by most civilised communities.

The present occupation of the ancient land of the Nile by Great Britain will eventually tend towards opening up, in the history and archæology of Egypt, much that has hitherto been a sealed book.

Whatever further discoveries may be in store, of one thing we may be certain—that Truth will never suffer in the end by more light.

# HANS SACHS, SHOEMAKER AND POET, WITH A WORD ON THE MASTERSINGERS.

By R. M'LINTOCK.

At the end of the twelfth, and all through the thirteenth century, contemporary with the later *troubadours* and *trouvères* of southern Europe, there flourished in Germany a school of poetsingers, mostly of noble birth, known as *Minnesingers*. Many examples of their work have been preserved, and these testify to the great natural ability and high artistic cultivation of their authors. But times changed; chivalry decayed, and the art of Minnesong degenerated, lost its inspiration, and became mechanical. In the fourteenth and fifteenth centuries, commerce increased, the cities rose into importance, and with wealth came the desire for the pleasures hitherto enjoyed solely by the dwellers in palace and castle. The citizens of Nuremberg, Frankfurt, and other places began to cultivate the arts of poetry and music, and to this end founded guilds similar in organisation and operation to those which at that time regulated and controlled both handicrafts and professions. These guilds were called Schools of Song; their members were divided into five ranks, according to their proficiency in the rules and practice of their art, thus:—

I. Students, studying the *Tablatur*, or code of rules for composition and metrics.

II. Amateurs, who had mastered the *Tablatur*.

III. Singers, who were able to sing correctly.

IV. Poets, who could write in ready made measures.

V. Masters, who had invented new measures and tunes to fit them.

This last and highest degree has furnished the names by which the members and their works are now known: *Mastersingers* and *Mastersongs*. The regulations of the *Tablatur* were minute and mechanical, and public performances and examinations were held, at which prizes were awarded, and penalties inflicted, according to the degree of exactness with which the rules had been observed. I have not been able to make acquaintance with the *Tablatur*, but some of its requirements can be deduced from those specimens given in this paper, which are divided into stanzas; those in couplets are not Mastersongs. It will be seen that each stanza corresponds exactly line for line with the other in each piece, and also in the placing of the rhymes, which are sometimes so far apart as quite to elude the ear. In this I have been careful to follow the original closely, merely adding for the satisfaction of modern ears the element of rhythm which is entirely absent from the originals. It will, also, be seen that there is a strong tendency to produce formless overgrowths or monstrosities in stanza-construction, inevitable when the qualification for mastership was the production of a new measure—and a complete lack of that grace which distinguishes the equally artificial verse-forms of France and Italy. Naturally, poetry could not be commanded—very few of the Mastersingers left any abiding name in literature, but of the few, the best known both in Germany and abroad is certainly Hans Sachs, the shoemaker of Nuremberg.

The life of Hans Sachs was by no means that of a typical poet, for it was long and prosperous. The son of a Nuremberg tailor, he was born in 1494—when Henry VII was king of England, and had still eight years to reign—and he died in 1576—when Elizabeth had been queen for over seventeen years. His life thus covers the whole of the Reformation period. Luther was his elder by eleven years, but died thirty

years before him—a stirring time in Germany, yet through which Hans Sachs appears to have gone with a very minimum of adventure. His father was well to do, and gave young Hans the best education then customary for those not intended for the learned professions: grammar, rhetoric, dialetics, and music; the grammar, of course, was Latin, and his works shew that he really learnt something of it, although he seems to have made acquaintance with the ancients through the medium of translations—Greek he certainly did not know. At fifteen years of age he was apprenticed to a shoemaker, and sometime during the next two years was initiated into the art and mystery of Master-song by Leonhard Nunnenbeck, a linen weaver, himself a Mastersinger. At the end of his two years apprenticeship, in 1511, he started on those travels, which to the German craftsman are (or were) as necessary a part of his industrial training as the apprenticeship itself. During his wanderings, which lasted five years, tradition says that he served for a while as a huntsman in the court of the Emperor Maximilian I; there is no direct evidence of the truth of this tradition, but it is not in contradiction with any known facts; certain it is that the young man saw much of life under various aspects, and during this time made his first essay in verse. His earlier pieces are mostly scholastically-treated sacred subjects: the mystery of the Trinity, the mystery of the Sacrament, and the praise of the Blessed Virgin, which are quite too far removed from modern ways of thought to be interesting as poems now. But here is a *Lover's Parting Song* written at the age of 19, which seems to me to reveal the genuine poet.

O cruel fate,
How heavy is thy hand on me!
Therefore my plaint I make full sore
Each evening and each morrow.

I feel thy hate!
When I in exile think to be
Earth's joys for me are darkened o'er.
Silent I bear my sorrow,
For now I must to exile go,
Which to my soul is sore annoy.
Dear love, let this thee soften!
Love's pleasure turns at last to woe;
As now to me, comes after joy
Heart-heaviness full often.
Exiled I am, for exile has no grief above
The grief of parting from my own heart's dearest love,
Whom I have so long served with loyal heart and true,
From whom I now must dwell afar,
Whom henceforth I may never view.

From all distress
God bless thee still by day and night!
Blest be those eyes that shine so fair,
And that white throat so slender!
And may God bless
Those rosy lips from every blight,
Also those twines of yellow hair,
And that sweet bosom tender!
Blessing be on that snowy hand,
Blessing be on that kindly heart,
Soul, and what else doth make thee!
I quit thee for a far-off land,
And so must bear a tongueless smart,
For now I must forsake thee!
I set me forth, but ah! my heart again looks back
Hoping to see my heart's own follow in my track.
But she, alas! is left such weary miles behind
That her sweet form no more it sees,
And so wails plaintive down the wind:—

"Dear heart! Heart's best!
How far behind me dost thou stay?"
Thou who to me art every bliss—
I singled out and chose thee

'Mid mirth and jest—
O why so soon must I away?
My bosom yearns and grieves for this—
That it no longer knows thee.
In body must I journey hence,
Though my true self will not depart—
O thence, dear love, my sorrow!
But since I leave soul, spirit, sense,
With thee, thou treasure of my heart,
O think on me to-morrow!
O heavy woe! O love beloved! O woe on woe!
I fear me, dearest love, thou'll see me never mo!
No other grief e'er made this heart so sorely bleed.
God bless thee, sweet, my own heart's love!
Now on the exile's path I speed.

Despite the thrill of earnestness which seems to run through this, there is no reason to think that it commemorates any real event; "Lovers' Parting-Songs" were a recognised form of poetical exercise, and a fashion of the time.

In 1516 the shoemaker-poet returned to Nuremberg, apparently never to leave it again for any considerable time, and immediately went to work to reorganise the Guild of Mastersingers, which had fallen into decay in consequence of the jealousies and dissensions of its members. A little later he began a manuscript collection of Mastersongs still extant, and of the four hundred pieces which it contains thirteen are of his own composition.

In 1519, being then twenty-five years of age, and having been received a Mastershoemaker as well as a Mastersinger, Hans Sachs was married to Kunegund Kreutzer, an orphan and an heiress. Although in all probability this was a pure *mariage de convenance*, it seems to have been a happy one, for, in spite of frequent allusions to the faithlessness of women in general, many of the most truly poetical passages in his works are those which describe conjugal affection.

During the next twelve years seven children were born of this marriage, all of whom died before their parents.

In the year following his marriage Hans Sachs almost ceased to write, and this abstention continued for a space of three years. It was during these three years that some of the most important of Luther's writings appeared, including his translation of the Bible—and out of his silence Hans Sachs emerged a Protestant. If there was any struggle in his mind, or regret at leaving the church in which he had been brought up, his writings—so far as they are represented by the selection from which I have worked—shew no trace of it. On regaining his voice in 1523 he produced the *Wittenberg Nightingale*—a vigorous onslaught, seven hundred lines in length, on the doctrines and practices of the Church of Rome. What little interest of a poetical nature this long tirade contains lies in the laboured allegory of the first hundred lines, and even this is scarcely worth reproducing here. Although seriously religious, Hans Sachs was no bigot or *crocheteer* of the kind which so soon split up Protestantism into a congeries of jarring and warring sects. He laboured hard to spread a knowledge of the Bible by versifying its narratives with the least possible departure from the very words of Luther's text—though often, as it seems to me, with but little perception of what was really edifying—and tagging thereto "conclusions" or "morals" of his own. In similar style he paraphrased the sermons of rival preachers, Protestant and Catholic, and makes merry over the unideal character of the Romish clergy; but, having regard to the time in which he lived, and the tone in which religious controversy has always been apt to assume, there is wonderfully little of the *odium theologicum* about Hans Sachs.

As a specimen of the sober humour which Hans Sachs could infuse into an attack on the degraded monasticism of

his time the following piece, entitled *Dusty Francis* may serve.

Tramping downhill, a vagrant wight
Once met an abbot none too bright
Who asked :—" Friend, whence descended ?"
He answered, so befriended :—
  " From far up yonder, sir."
" You mean from Heaven !" The abbot said
" From Heaven !" The abbot raised his head—
" Was Peter in his station ?
How went your conversation ?"
  Then did that vagrant man aver :—
" He asked me if this nether world
Of monks had grown quite bare.
I said their hosts were growing small,
And he that up there none at all
These years—aye, five and twenty—
Had come, instead of plenty."
The abbot said a prayer,

And rode on, thinking very deep.
And that night, when he fell asleep,
He dreamt that he ascended
The way that upwards tended,
  And when to Heaven's gate he came,
He found none waiting at the same
Save Francis, him who founded
The barefoot friars, who, grounded,
  There on the threshold lay.
And over him, two fingers thick,
The dust lay, by the Lord!
" O holy man !" the abbot cried,
" Wilt thou not rise, and go inside ?"
Then Francis answered :—" Truly,
I came up hither duly,
But Peter, by my cord,

Gripped me and said :—Where now away?
Thy rule prescribeth to this day

That two and two together
Shall monks go in all weather—
  Alone then, comest thou?—
Lie at the door and patient wait
Until another come this gate.—
And here from all men sundered
Have I lain years three hundred
  And twenty-eight till now;
And still no brother this way comes.
They gather in their stuff;
They ply their cant and human wit;
They seek God's glory not a whit;
His word they have forsaken?"
Then did the abbot waken—
But he had heard enough.

As the years went by the long level of worldly prosperity began to be spaced out by gravestones; one by one Hans Sachs's children died, and when, in 1560, after more than forty years of wedded life, his wife also was taken from him, the old man was left with no family but four grandchildren left him by his eldest daughter. Yet his sorrows never furnished themes for his verse; it is only when he tells us how his dead wife's radiant form appeared to him as a vision of the night, with the assurance that she was among the blest; when we learn incidentally that long years previously a similar vision had been vouchsafed to him of Leonhard Nunnenbeck, his master in the art of song; and when we feel the thrill of genuine emotion which animates his poetry when he has occasion to describe a happy wedded life—it is only by piecing together these and other less palpable indications that we arrive at the conviction that Hans Sachs was a man of strong affections and feelings—as we expect a poet to be. There is one piece, written only just before the death of his wife, which shews, with a directness rare with Hans Sachs as with most of his contemporaries, that the old man was

troubled by misgivings about his poetical vocation and the durability and utility of his work, and at the same time furnishes the very strongest evidence that his vocation was genuine. This is the *Conclusion to his Second Book of Poems*, and although it is rather long I shall take leave to introduce it here.

In August on a day
I through the fields did stray
Beyond the city's bound.
With weariness profound
My heart was sorely smitten
For what my hand had written.
And so, rest seeking, I
Did presently espy
A quiet tree-thrown shade.
Thereunto did I wade
Through grass and clover green,
And lay down, from my teen
And very bitter cumber
To lose an hour in slumber.
The winds were softly sighing,
And there in stillness lying
So peacefully embowered
Sleep quickly overpowered
My eyes, yet did I seem
To hear, as in a dream,
Dame Reason's voice full soft
Call to me from aloft:—
"Come, tell me, old man, why
So sorely thou dost try,
And plague thy soul and heart
With weariness and smart
Thy mother-tongue to use
In song, and so dost lose
Thy rest, from first to last?"
I answered:—"In the past
I held my native song
No labour; I was strong,
And so did take the same
But for a pleasant game,
And, for that God above
This gift hath given in love,
I hide not, like a slave,
My talent in the grave,
But therewith praise the Lord
And joy to men afford.
Virtue I sing, and duty,
That youth, abloom with beauty,
Untouched by vice may go
(Which ever bringeth woe)
And ever seek the best.
Also with honest jest
Love I to banish sadness;
Yet free from taint of badness,
From envy, hate, and wrong,
Hath been and is my song
These forty years and four
Thou knowest evils sore
From idleness do spring
Which man to ruin bring,
From work man's heart ne'er stays
And, therefore, with these lays
My hands I occupy."
Then Reason made reply:—
"With fond imaginations,
Dreams and speculations,
Thou enfeeblest thy sense;
The time is not far hence
Thou shalt be doting seen
In deed, and word, and mien

As many are—believe it!
E'en now thou may'st perceive it:
The keen wit thou didst own
And memory are flown,
And flown with them thy force.
The golden river's source
In thee runs dry, my friend.
I say, then, make an end,
And lay thy rhyming by."
I spake:—"I not deny
But that I feel full sore
That perfectly no more
From heart with bliss upbuoyed
And soul's desire uncloyed
My songs flow, all elation—
But ofttimes with vexation,
Not as of old clear-rushing,
From keen perception gushing,
So dull and slow they rise
That often I devise
To make an end of song.
Yet stirs with impulse strong
Something within me dwelling,
Or in my being swelling,
And prompteth secretly
To still love poesy
Nor ever rest, but what
The thing is, I know not,
Whereby I thus am led."
To this Dame Reason said:—
"Nought is it but the craze
That from thy tuneful lays
Thou shalt inherit fame
And do good by the same.
For so it is recorded
Are poets best rewarded:—
Their name and fame in story
Shine out with deathless glory.
Lo! this it is that urges
And thee to writing scourges;
But thou shalt ne'er receive
Such pay, thou may'st believe.
For thou hast with thy pen
Drawn on thee from all men—
From every rank and state—
Envy and bitter hate.
For now the world, in sooth,
Loves not to hear the truth;
Her works to evil run
And she the light must shun,
Thence cometh to thy name
More enmity than fame,
Because thou can'st not feign.
'Twere best, then, spare thy pain,
Old man, ere cometh worse—
For guerdonless thy verse,
And thankless, falleth dead."
And with these words she sped
Swiftly away. And now
So loudly on a bough
A bird sang that I woke
And in my heart thus spoke:—
"So is it, much I fear
As Reason warneth clear,
With me and my renown."
Then made I for the town,
Paged and together laid
With index truly made
And what to print belongs
This second book of songs,
Thereto this piece composed
And so in sorrow closed
That for all thanks and fee
I have but enmity,
And for my goodwill, strife—
Intending for my life
Henceforth to quit all song
Lest to me yet worse wrong
Do come and mischiefs wax.
*At Nuremberg*, HANS SACHS.

But although when he wrote this the author was in his sixty-sixth year, he had still a good piece of his life to live and much of his work to do. In rather more than a year from the death of his wife he married again, taking for his partner a girl of seventeen, named Barbara Harscher, and, unequal as the match appears to us, it seems to have been as happy as most marriages are now. I shall have occasion presently to notice the system of strict repression and subjection which he, in common with everybody else at that time, thought to be the natural and proper treatment for women. Here I shall only remark that perhaps the general acceptance of that system made marriages of convenience less objectionable than we now suppose them to be; they must certainly have been much more universal. Hans Sachs's second wife, it appears, was both beautiful and good, and as he lived nearly fifteen years after marrying her, his latter days were probably passed in an atmosphere of comfort which as a widower he might not have enjoyed. He died in January, 1576, having completed his eighty-first year the previous November.

I have already stated that Hans Sachs was a prosperous citizen; whether his literary ability contributed directly to his prosperity, I have not been able to ascertain, but as copyright-laws were unknown in his day, it probably did not; indirectly it certainly did, for it made him an important man in the eyes of his fellow citizens. It is certain also that he carried into his literary work some of the habits which usually mark the good business man. In re-writing a story by any previous author it was his custom to name in the opening lines the source from which he took it, usually the author's name, and in some cases the title of the book; his own name generally, even in his dramas, was made to form the closing rhyme, the date of composition was very commonly attached. Several times during his life he wrote a summary of his

poems up to date; the latest of these summaries gives the gross number of pieces as something over 6,000; he must therefore have produced regularly during the period of about sixty years that his literary activity lasted two poems per week. Of this enormous bulk enough is still extant in print and manuscript to make it tolerably certain that there is no overstatement in the account. In addition to being perhaps the the most voluminous, Hans Sachs was certainly the most popular author of his time; his supremacy was confessed by rival poets during his life; a most unusual thing in that age. This popularity he doubtless owed mainly to the qualities and gifts which he possessed, but partly also to the age and circumstances into which he was born. It was the Reformation-time—the time of perhaps the greatest revolt against a debased religion and the tyranny of its ministers that the world had ever seen. And Hans Sachs's qualities and gifts were precisely such as to make him a fit representative of the best and worthiest of his fellow-citizens and fellow-countrymen. Piety without bigotry, earnestness without moroseness, learning without pedantry, humour without flippancy, industry without sordidness,—and all these qualities harmonised and humanised by a vein of true poetry—the wonder is not that Hans Sachs was popular in his own day, but that he should be so nearly forgotten afterwards. To account for this latter fact I think greater weight will have to be allowed to external circumstances; the regular development of a national literature was interrupted by the outbreak of the Thirty Years' War, and in the horrible devastation which then ensued all taste for literature was well nigh trampled out, and, worse than this, all power of independent thought seemed to perish. When the sky cleared a little and men once more began to think of writing books, all that was produced was either dryasdust disquisition or spiritless imitation of foreign—mostly French—models.

This lasted—with some faint indications of improvement in the latter part of the time—until the eighteenth century was half gone. But even then, the revival of literature brought no return of popularity to Hans Sachs, and for this I think his personal qualities may account. He was too perfect a son of the sixteenth to please the eighteenth century. Reverent, *naïf*, simple, even to credulity, but withal as far from mysticism as from scepticism, there was nothing in him to attract the men and women of the eighteenth century, irreverent, incredulous, and yet with a haunting desire to know what some one has called the "otherness of things." Then, he had written no monumental work which it was everyone's duty to know—and his morality was old-fashioned. In the political world—I am speaking now of the days preceding the French Revolution—the idea of an independent and united Germany was perhaps latent, but assuredly was not yet visible, and Hans Sachs's one principle that the empire must be preserved, was equally certainly out of favour. Things are altered now--Germany is once more an empire; and German writers — with the exception of a certain school of novelists—are not inclined to run after foreign models, but in face of the soul-searching and picture-painting which we now expect at the hands of our poets, the simple narratives of a Hans Sachs have too much of the savour of milk for babes to find much favour among the men and women of our time. Yet the greatest poet of Germany, Goethe—himself a soul-searcher and a picture-painter upon occasion—has bestowed a word of praise on the old shoemaker-poet, has condescended to write a story professedly in the manner of Hans Sachs, and has elaborated and deepened in significance to suit his own purpose some of the old man's simple sketches. And there is another way in which Hans Sachs's work may after all find a public both in Germany and beyond, and that is by the rich store of material which

he offers to the historian and sociologist. For instance, does not the following poem reveal in a striking manner some of the difficulties with which honest traders had to contend in the sixteenth century?

### THE PIOUS NOBLES.

In Frankfurt many years ago—
The imperial city—it happened so
That on a day a villain young
In sight of all was to be hung,
And though a ruffian rude, in sooth
He yet did seem a comely youth.
In visage handsome, tall and straight,
Fine limbed, and of a courtly gait,
And in his vesture trim and clean,
Yet had the carle a robber been,
And Augsburg city on his head
Had set a price alive or dead.
Now must he perish, and in man
And maid soft ruth to stir began;
Yea, but to see him was a pity.
  Now, having judged him in the city,
Before the deathplace they might win
They needs must pass a certain inn
Where many stranger nobles lay;
To sign some treaty tarried they
If such the Frankfurt nobles pleased.
These strangers also straight were seized
With kindly pity and compassion
To see led forth in such ill fashion
A youth so gallant and so bold
Who scarce had twenty winters told.
To die so young they thought a grief,
And straightway, after counsel brief,
Unto the city's rulers went
And humbly did their prayer present
Thinking that they perchance thereby
Might for the youth adjudged to die

Some favour in the rulers cherish,
And he not miserably perish,
Dying beneath the hangman's hand.
  Then did the council make demand:—
"Dear lords, we pray you, say in truth,
Know ye not wherefore this same youth
This day unto his death must go?"
The nobles spake:—"We do not know;
Only we grieve for his young life—
As truly doth man, maid, and wife
Think pity he so young should die."
Then did the council make reply:—
"Dear lords, we tell you now in brief—
This youth is but a highway thief;
To traders hath he, overdaring,
Closed up the roads when they were faring,
And put them unto ransom too
Upon the Spessart with his crew,
And other mischiefs hath he wrought,
Wherefore we hang him, being caught.
But so well have ye prayed to-day
That we are moved our hand to stay,
Yea, in your honour we here give
This youngster our good leave to live,
And free him from his present bands—
Yet shall he straightway quit these lands,
And banished be for ever hence;
So punish we his great offence."
  Now when the pious nobles heard
The reverend council's weighty word
With horror they to speak began:—
"How? What? A robber? Hath the man
Fleeced traders on the Spessart? He—?
And he no lord of high degree?
Nay, sirs, we truly knew it not—
Away with him!—or on the spot
Strike off his head. Each base-born peasant
Imagines it as right as pleasant
To turn highwayman thus—But sirs,
Nobility alone confers

Upon its scions great and small
The right fat burghers so to maul
That they turn out their hoarded treasure.
Let those who hunger for such pleasure
Note—'tis and ever was the same—
Hunting must be the nobles' game!"
With that those nobles took their leave,
Nor prayed they for the least reprieve.

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THE CONCLUSION.

Right joyful should we traders be
To see our highways made so free,
And note how in each march and county
Our worthy nobles, of their bounty,
Take care that on the public way
No thief shall ply his trade to day,
Unless he be of noble race,
And so have license by God's grace.
Now may all folk in safety wander
From Frankfurt here to Leipsic yonder,
And trading traverse wood and wold,
Though evil was their fame of old.
The Spessart freely may one tread
Bearing a gold-crock on his head,
And nought by robbers need he lose.
This ye may credit, if ye choose—
But guard yourselves 'gainst all attacks
On every road, counsels Hans Sachs.

In addition to the robber nobles and their brutal followers, quiet folk were liable to the masterful begging of disbanded *lanzknechts* or soldiers, who were engaged for terms of service, long or short, by every petty potentate who enjoyed the right of private war, and between their engagements wandered about the country, ever ready for a brawl, enforcing a scanty and uncertain subsistence from the charity or fears of the inhabitants. Hans Sachs has many

a fling at them, their swearing, drinking, gaming, fighting, and starving life; but one of his quaintest notions is to imagine a party of them in Heaven.

St. Peter mit den Landsknechten.

Neun landsknecht kamen auf ein gspor
Hinauf gar für das himeltor
Und klopften trutzig an darvor,
Wolten hinein und in dem himel garten:
  Sant Peter sprach:—"O Herre Got,
Daus ist ein arm nackete rot,
Laß sie herein! Es tut in not!"
Er sprach:—"Nein, Peter, laß sie daußen warten."
  Als die landsknecht lang mußten daußen harren
Da fiengens an zu fluchen und zu scharren;
Sie fluchten sacrament, leiden und wunden.
Sant Peter dise flüch nit kent,
Meint, sie redten vom sacrament,
Und von des Herren tot und ent;
Dacht:—"Frumer leut hab ich vor nie gefunden."

Sprach;—"Her! ich hab an disem ort
Von der nacketen rot gehort
So vil heiliger guter wort;
Ach, laß sie rein, und hab mit in gedulde!"
  Der Her sprach:—"Du magsts laßen rein;
Du must mit in behangen sein;
Sie sint mutwillig allgemein.
Geräts nit wol, so gib mir nit die schulde."
  Sant Peter ließ sie ein mit freuden ganze,
Ein landsknecht bracht dem andren ein umbschanze,
Darnach fiengen sie an zu hadern und zu balgen,
Hauten einander lam und krum.
Sant Peter zant sie an darum:—
Was habt ir für ein umerdum?
Hebt euch wider hinaus an lichten galgen!"

Sie griffen tückisch in die wer,
Sprachen:—"Hinaus bringst uns nit mer."

Sant Peter reut der schimpf gar ser,
Und disen hochmut tet dem Herren klagen.
  Der Her sprach:—"Sagt ich dirs nit heut,
Es weren frech mutwillig leut?
Ge hin und eim engel gebeut
Die trumen vor der himeltür zu schlagen,
  Und das er darmit einen lerman mache."
Sant Peter verordnet balt dise sache.
Sobalt die landsknecht erhorten die trumen,
Loffens naus für des himels tor,
Meinten, ein lerman wer davor.
Sant Peter balt beschloß das tor;
Seit ist kein landsknecht in den himel kumen.

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## ST. PETER AND THE SOLDIERS.

Nine broken soldiers on a day
To Heaven's high portal made their way,
And boldly thereat hammered they,
Thinking to cadge of all who dwelt about there.
  Then Peter cried:—"O Lord, but view
Outside the gate, this wretched crew,
Naked and poor—O let them through!"
The Lord said:—"Peter, let them bide without there!"
  Now when the soldiers found they there might tarry
They 'gan to scuffle, ply their thrust and parry,
And swear—as when down here they sorely try us.
St. Peter knew not that they cursed,
But thought them in that Scripture versed
Wherein the Lord's death is rehearsed,
And said:—"Were ever folk before so pious!"

"O Lord," he thus his prayer preferred,
"From those poor fellows have I heard
Full many a good and holy word—
O let them enter, for thy loving kindness!"
  The Lord spake:—"Well then, let them through.
They'll give thee soon some work to do,
For they're a wilful wayward crew.
If aught goes ill blame nought but thine own blindness."

Then Peter ope'd the gate with no more battle,
And straightway one the dice began to rattle,
Then they fell out and furious was the banging,
And all, ere long were cut and lame;
Peter in hot haste at them came:—
"What! fighting here in Heaven? For shame!
Get back to earth, the gallows waits your hanging!"

They gripped their weapons with a roar:—
"Nay, out of this we go no more!"
Then Peter rued the jest full sore,
And cried unto the Lord aloud for pity.
The Lord spake:—"Said I not to-day,
A wilful, wayward crew were they?
Go bid the angel trumpets play
And drums strike up without the heavenly city
As if a foe were even on our border."
With goodwill Peter for the thing took order;
And when the soldiers heard the angels drumming
They outran all the heavenly quire,
Thinking the foe their swords would hire.
Then Peter locked the door in ire,
And since has not been vexed by soldiers coming.

In addition to his Mastersongs and narrative pieces, Hans Sachs also wrote plays—tragedies, comedies, and Shrovetide pieces which he tells us were performed with applause in other towns as well as in Nuremberg. When, however, we think of what the pre-Shaksperian drama was in England, and call to mind that when Hans Sachs died Shakspere was scarcely twelve years of age, we shall not expect a great display of art in the old shoemaker's dramas. Looked at from the standpoint so gained, Hans Sachs's plays certainly do not fall below the level of his other work, but I cannot say that the selection of them to which I have had access enables me decidedly to agree with Mr. Sime (*Encyc. Brit.* art. "German Literature"), when he says that they contain Hans Sachs's

best work. The plays are marked by the same qualities as the non-dramatic pieces: uncommon common-sense, perfect clearness, kindly humour and occasional absolute pathos; but as dramas they are rudimentary. The tragedies and comedies differ from narrative poems or epics only in having their descriptive parts reduced to the proportion of the barest stage directions. The distinction between tragedy and comedy is very imperfectly grasped; thus, *The Unlike Children of Eve* is a comedy, although the Almighty himself is one of its characters, and the death of Abel occurs in the fifth act, while the story of *Fortunatus with the Wishing Cap* is a tragedy; and there is no real life in either. *Charon and the Ghosts* is a tragedy, although it has neither plot nor action—and is, in fact, one of Lucian's *Dialogues of the Dead* with a little alteration. The Shrovetide plays are sometimes mere carnival-processions of maskers, with a few lines of naïvely appropriate verse given to each character, and sometimes more or less elaborate farces which must have been a great advance on the coarse and tasteless buffooneries which had been customary in the times before Hans Sachs. For Hans Sachs is never coarse—his language is sometimes a little more direct than we are accustomed to use in literature; in the tolerably extensive selection from his pieces of all classes from which I have worked, I have found only one poem which on account of the language employed would need to be excluded from good society at the present day, and that one piece is a dialogue between three ladies over shortcomings of their respective house-maids in the matter of cleanliness. And even when reproducing the essentially unwholesome stories of Boccaccio he contrives to keep his own hands and his readers' minds clean. It is only when he holds forth on the education and status of women that we are forced to protest against his notions—or rather the notions of his time, above which Hans Sachs never rose—and time has protested

more effectively than we could hope to do. A few quotations from his version of *Patient Griselda* will shew this.

When Griselda's husband informs her that her infant daughter must be made away with she answers :—

Most gracious lord, and husband dear,
I and my little daughter here
Belong to you by your free choice,
And wait our sentence from your voice.
I ask not to be spared in aught,
For I have yielded word and thought,
And wholly, both in time and measure
Your Grace's will shall be my pleasure.
* * * * *
While I on earth shall have existence
Shall you in me find no resistance.

And when a soldier comes to take the child she gives it up without a murmur :—

Then take the guiltless thing and go,
For that my lord will have it so,
And all thy masters' words obey.
Yet will I thee for God's sake pray
That thou thy grace so far extend
As not to let the wild beasts rend
That sweet form—or in forest grim
Foul vultures tear it limb from limb.

A second child, a son, she gives up with almost identical words. And when the prince tells her that she is not good enough to be his wife, and must go back to her father the herdsman, she answers with a humility almost ironical :—

O noble sir, long, long ago
I thought, and in my heart did know
That I, with my ignoble birth,
Had not about me so much worth

As suits a handmaid to your Grace,
Nor craved I for your consort's place.
And ever in your princely hall
Did I myself your servant call.
For all the kindness I have had
These fourteen years, I am most glad,
And thank the Lord and you for giving.
If with you now is no more living
Willing am I it should be so;
Home to my father will I go,
In poortith live from morn to morrow
And rest a widow, with no sorrow
For that your wife's place once was mine.
Your spousal ring I here resign;
These robes I'll doff and feel no shame:
I brought no such things when I came.
The rest, and all your jewels' hoard
Are safely in your chamber stored—
For them, and for my princely state,
Have I but envy won, and hate.
Yet have I to your Grace one prayer:
You will not let me wholly bare
And naked to my father go—
For I have left here, as you know,
That which is every maiden's dower—
So give to clothe me in this hour
A smock alone, that men not see
Me bare—yet what you will, let be!

Here is pathos indeed—but pathos to make a right minded man of our time, not pitiful, but angry—for somehow, in spite of what seems the exaggeration of the character, it lives. By contrasting Griselda with any possible ideal woman of to-day a notion may be gained of the difference between the mediæval and the modern conception of the relationship between the sexes. When Griselda's troubles are over the moral of her story is drawn in the epilogue, under three heads, like a sermon. Firstly—Daughters should be

taught to have no will of their own; then their husbands will have no trouble to break them in. Secondly—Wives, obey your husbands (see St. Paul.) Thirdly—Husbands, love your wives (see St. Peter.) Not a word in condemnation of the wanton cruelty inflicted on poor Griselda. Almost of a piece with this is the following, which is the conclusion of a story of unlawful and unhappy love, taken from Boccaccio.

> Then did the prince's grief mount high
> With all too late a sorrow,
> And dead those lovers true did lie
> Both in one narrow dwelling
> All at Salerno as the tale we read.
>   And by the tale is clearly shewn
> That by a dismal morrow
> Such love must for its joys atone.
> So, wives and husbands, heed the telling
> And get your children mated with all speed,
>   Ere victor love in their young hearts be leaping.
> A daughter is a fruit for no long keeping.
> Grief may she bring that all your patience taxes
> When she laments that jewel lost
> That's not won back at any cost—
> Roses brings June, at Nuremberg, Hans Sachs says.

That love between the young and unmarried is very natural, very dangerous, very wrong, and very unhappy, is a theme to whose enforcement Hans Sachs devotes story after story. And such ideas were not peculiar to him or to his country, but were held by the good and respectable folk of all christian lands at that time—and for long afterwards. We can trace them in our own literature, in Shakspere, and still more plainly in Milton. I think we must see in them the remains of the asceticism and monasticism which had prevailed in the earlier centuries, and which were but the obverse of the oriental harem-system.

In all other points the morality of Hans Sachs is remark-

ably modern. He loved peace—one might almost say peace at any price, and this I take to be the reason for his imperialism in politics; the peace of the empire would be better secured by a powerful emperor than by a crowd of semi-independent princes always ready to quarrel. And he was an advocate of temperance, almost to the verge of teetotalism. Very amusing is his allegorical description of "Good Monday," and the long train of evils and discomforts which it brings; amusing also in its outspokenness is his *Song of the Soakers*. The old man's boast that all that he had written had been in praise of virtue and dispraise of vice is fully borne out by his works; only his conception of virtue is sometimes not exactly ours.

I must not finish without saying something of Hans Sachs' knowledge of books, which is not sufficiently brought out in the extracts from his works here given. His stories are very rarely inventions; sometimes they are popular or traditional, most frequently, however, they are borrowed from some predecessor in literature whose details he reproduces with an exactness, which we are inclined to call slavish, but which was the universal fashion of his time. His library contained translations more or less complete of Homer, Virgil, Ovid, Apuleius, Plutarch, Herodotus, Xenophon, Herodian, Josephus, Livy, Valerius Maximus, Justin, Suetonius, Pliny, Æsop, and Boccaccio; sundry old German chronicles, a *Northern History*, and several books of travel. Hallam presumes that "uneducated, unread, accustomed to find his public in his own class, so wonderful a fluency was [in Hans Sachs] accompanied by no polish, and only occasionally by gleams of vigour and feeling," but the presumption is certainly, in part at least, erroneous. Hans Sachs was, for a layman of his time, well educated; he was remarkably well read; there is evidence that he was well appreciated by all ranks in society, and I think that enough

of his work is here given to shew that he had abundance of vigour and feeling, and the talent for story-telling in an eminent degree. For polish, in the sense in which Hallam would understand it, we can hardly look in Hans Sachs. Hallam appears not to have read anything of Hans Sachs' work, but to have based his opinion on an anonymous article in the *Retrospective Review* (vol. x, p. 113), the writer of which displays a curious mixture of knowledge and ignorance, gives no quotations, and sets it down as Hans Sachs' greatest merit that he was a good Protestant.

What is the exact rank to which the worthy old shoemaker is entitled in the hierarchy of literature, I do not pretend to determine, but although Germany produced no writer of equal merit until Lessing appeared, I scarcely think that Hans Sachs can claim a higher place than our own Crabbe, whom in some points he much resembles. He is the poet of a time and of a country, not of the world and of eternity, but even so has his importance and interest for all students of history and humanity.

# ON RECENT LOCUST PLAGUES IN CYPRUS AND IN NORTH AMERICA.

By J. BIRKBECK NEVINS, M.D. Lond.

Since intercourse with the Western States of America has become so much more common many of us have known of the injury, if not the ruin, of our friends by the devastations from so-called "Grasshoppers," * and since the Island of Cyprus has come into the possession of this country, the Government has published more than one Parliamentary Paper, entitled *Report on the Locust Campaign of*—such and such a year—and the employment of this term "Campaign" will be seen to be well deserved, when we learn the ravages which these insects have recently committed, and the extensive operations necessary on the part of Government for their prevention in future.

The history of the Locust plagues in Cyprus, previous to our occupation of it, is briefly as follows †:—The locusts having for many years caused great destruction of the crops, the Turkish Government (at that time in occupation of the

* The terms "Grasshopper" and "Locust" have often been used almost indiscriminately, and in the United States, until recently, the settlers commonly called them "Grasshoppers." Naturalists appear now to be pretty uniformly agreed in distinguishing the two forms of insect, and in applying the name of Locust to the devastating form, and that of Grasshopper to a less injurious form of insect. The Locust may be described shortly as having short and comparatively thick antennæ, while the Grasshopper has long and tapering ones, and the Locust has three joints in the foot, while the Grasshopper has four. The antennæ present the most striking obvious difference.

† *Parliamentary Report Cyprus Locust Campaign*, 1884, C. 4189, p. 10—Eyre & Spottiswoode, London (from which the portion of this paper relating to Cyprus is chiefly taken).

Island), attempted to put down the pest by collecting the *eggs* and burning them, and by trying to catch the flying insects; but it failed to make head against them. Mr. Rd. Mattei, however, commenced experiments in 1863, which resulted in the system that has lately proved an eminent success, and his name deserves to be remembered with honour and gratitude. Said Pasha, a governor of unusual intelligence and energy, actively supported him, and although their appliances were still very far from complete, their success was so great that in seven years, by 1870, the locusts were almost exterminated, and it was officially reported that "the locust had ceased to exist in Cyprus." This unfortunately was not quite true, for some of them had escaped destruction in the more inaccessible parts of the Island, and as each locust lays from thirty to one hundred eggs yearly, it will be readily seen that in a very few years an enormous increase might have taken place from a single pair of insects.

1st year (say) 30 eggs.
2nd and 3rd years $30 \times 30 \times 30 = 27{,}000$.
4th and 5th years $27{,}000 \times 30 \times 30 = 24{,}300{,}000$.
6th and 7th years $24{,}300{,}000 \times 30 \times 30 = 21{,}870{,}000{,}000$.

*i.e.*, nearly twenty-two thousand million locusts in seven years from only a single pair of locusts in the first instance.

In 1875, in fact, there were so many that it was useless pretending to deny their presence, but they were pooh-poohed by the then Turkish Governor who had succeeded Said Pasha—"What!! devastating locusts in Cyprus!! absurd! Had it not been *officially* published they were all exterminated!"* and accordingly until 1878, nothing was really done. At that time the British occupation of Cyprus commenced, and in the following year thirty-seven and a half

* *Locust Campaign Report*, C. 4189, p. 10.

tons of EGGS were collected and destroyed. But fresh swarms hatched and multiplied until our government gave practically unlimited authority to Mr. Brown, the present government engineer, who has again succeeded in reducing the locusts to a few scattered individuals, which cannot be described as a swarm anywhere in the Island.*

The extent of the operations, however, which were necessary may be faintly realised by hearing that in 1884 above 2,000 men (2,093) were employed by the engineer in conducting the work. The result was such that in 1881–82 above 1,300 (1,330) *tons of eggs* were collected and destroyed at a cost of £12,262. Yet even this produced no apparent diminution in the number of the locusts in the following year (*Report* 1884, p. 10). Now 1,330 tons of eggs convey but a very indefinite impression to the mind, but if we recollect that a cart load of coals is about 2 tons, then we have about 700 cart loads of these eggs destroyed in a single year; and if these carts were in an unbroken string, one after another, they would reach nearly two miles, or from the Liverpool Town Hall to the great Exhibition Buildings near the Botanical Gardens, which conveys a more tangible idea of their amount.

### LOCUST DESTRUCTION.

So far for the destruction of the EGGS before they become injurious by hatching; but the locusts themselves were present in such numbers that 95,000 millions were computed as having been destroyed by the course now to be described.

Mr. Brown obtained all the information possible upon the subject, and found nothing equal to the method originally invented by Mr. Mattei, to whom he awards the credit with the most unreserved candour. This method was snubbed

* *Locust Campaign*, 1885, p. 8.

when first proposed, and is not to be found described in the American or other publications that I have had the opportunity of examining. I therefore wrote to Mr. Brown himself, who very kindly sent the description, accompanied by a lithographed sheet, which, with his permission, is copied in Plate II on a reduced scale, and he sent also samples of the materials used in making the screens and pits so successfully employed.

### Mr. Mattei's Method for Locust Destruction.*

In all the accounts that we read of locust invasions, it is represented that nothing will stop their progress when upon the march; they will climb over walls, and enter into windows; they march into rivers until the dead bodies of the first comers form eventually a pontoon upon which the following swarm can cross, as it were, on dry land; and they will march into burning embers, pushed on by those behind. In reading the vivid and life-like description of a locust plague in Palestine by the prophet Joel (ii, 7–9), "They shall run like mighty men; they shall climb the wall like men of war; and they shall march every one on his ways, and they shall not break their ranks: . . . they shall run to and fro in the city; they shall run upon the wall; they shall climb up upon the houses; they shall enter in at the windows like a thief," it seems as if nothing would be capable of stopping their progress, and when we learn what has really proved the wonderful material that has accomplished this object, we almost hold our breath for the moment in surprise that such a simple, and apparently contemptible means should have produced such a result. It is neither more nor less than a strip of American oil cloth, 4 or 6 inches deep. Their feet are capable of holding on to any thing that has roughness or projections as may be evident from the sharp strong hooks

* MS. Letters from Mr. Brown.

which terminate all their feet (Plate III), but as soon as they try to climb over this strip of smooth glazed oiled cloth they slip down, and they try in vain to overcome the obstacle.

The method, therefore, invented by Mr. Mattei, and adopted by Mr. Brown, was to stretch long screens of coarse canvas, about a yard deep, across the country, in front of their line of march, and upon the upper edge of this to have a strip about four inches deep of American oiled cloth, as shewn in the drawing. At moderate intervals pits are dug, about six or eight feet long and three or four feet deep, round the mouth of which thin sheets of zinc are laid upon the ground, and the locusts, encountering this screen in their march, climb up it until they slip down from the oiled cloth. After two or three fruitless attempts, they then change their line of march and fall headlong into the pits, the lower ones being kept down, and eventually smothered by the constantly fresh additions marching and falling into the pits. When these are about half full of locusts the labourers fill in the earth and stamp it down, by which they are effectually killed.

In this way, in the year 1884, above twenty-six thousand (26,016) pits were more or less filled by the locusts (*Report* 1884, p. 6), though far more than this number of pits had been dug. After carefully calculating the space filled by all these pits together, it amounted to 15,919 cubic yards (p. 6), which, probably, conveys no idea whatever to the reader any more than it did to myself when thus stated. But if we remember that a cart-load of earth, according to the ordinary standard in making railway embankments, &c., is one cubic yard, we then find that we have nearly sixteen thousand cart-loads of locusts caught and killed in this manner in this single year. Now, if these carts were again in an unbroken string they would reach above forty miles, or from the Town Hall, in Liverpool, to ten miles beyond Manchester, which

may help us to realise the number thus destroyed, and the injury they would probably have done if allowed to continue their devastation.

When they first hatched and began their march, the numbers were comparatively small, but they rapidly increased as the season advanced, thus—

| | | | | | |
|---|---|---|---|---|---|
| On the | 5th of April | only | 31 pits | were filled in | one day. |
| „ | 12th „ | „ | 238 | „ | „ |
| „ | 19th „ | „ | 783 | „ | „ |
| „ | 30th „ | „ | 919 | „ | „ |

After which the numbers rapidly diminished until the 13th of May, when the remaining locusts had acquired wings, and flew away (p. 6).

And now, what amount of machinery, or plant as we may call it, was required to accomplish these results? The number of men employed in 1884 was above two thousand (2,093), the total cost has been above £66,000; and the length of canvas required for making the screens was three hundred and fifteen miles. If now, we again endeavour to realise this necessary length of canvas, we will imagine it starting at Liverpool and stretched across England to the extreme point of Yorkshire, beyond Hull; we will then take it up to Newcastle; then bring it across England to Carnforth, at the head of Morecambe Bay; and, lastly, bring it back again through Lancaster and Preston to Liverpool, and we shall just have used up the canvas employed in one year's campaign against these locusts in the Island of Cyprus alone.

Of course it is not implied that it was actually stretched out in one unbroken screen, for it was in reality made into screens each about fifty yards long, which were then joined together into screens of varying sizes, according to the circumstances of the place, as may be judged from the appended

map of Cyprus (Pl. I), in which it will be seen that the parts infested by the locusts were almost exclusively Nicosia, Larnaca, and Famagusta, in which the number of locusts differed exceedingly:—

In Nicosia 7,687 pits were filled.
In Famagusta 7,961 pits were filled, but
In Larnaca only 271 pits were filled.

It is curious to see that in the very centre of the locust districts is a space marked A, in Nicosia, in which no locusts were found. And, again, it is noteworthy to observe that while no locusts were known to exist in the unshaded part of the Famagusta portion of the Island in 1884, the small district, marked by a round spot in Cape St. Andrea, furnished nearly one-fourth of the whole of the locusts killed in 1885—the following year.

The number of screens actually made in 1884 was 11,083 (p. 7), the longest of which was twenty-seven miles long. This embraced a breeding ground which would be about equal to the space between Liverpool and Southport and back by Burscough Junction to Liverpool again.

The result of all this labour and expense has been that in his last report to Government, just published, Mr. Brown says, that he has ridden through the length and breadth of the previously infested districts, and has seen scarcely a locust; while the saving of crops has been so great that all the expense of above sixty-six thousand pounds has been more than recouped to the island by a single year's saving; the destruction from the locust ravages for many years being estimated at above £80,000 a year (*Report* for 1885, C. 4620, p. 8).

Still, however, incessant care and vigilance will be requisite, owing to the enormous rapidity with which the locusts increase, and the indifference of the Islanders them-

selves about anything short of actual devastation. For in the district about Cape St. Andrea, it is now discovered that the villagers knew that there were locusts for some years back, but "they were so few, they did not matter," until, in 1885, they had multiplied to one-fourth of the entire number destroyed in the campaign. Mr. Brown, therefore, proposes that the whole of a village should be fined whenever the Government discovers locusts in the neighbourhood of it, unless the village authorities have themselves reported their presence. And this he hopes may prove effectual in the future.

## North American Locust Plagues.

### Infested Regions.

These have been far more extensive and destructive than the plagues in Cyprus, as may readily be supposed, from the greater extent of the country. The "Rocky Mountain District" of America from which they are never absent, is about half as large again as the whole of France (about 300,000 square miles* as against 200,000), while the districts which the locust flights devastate from time to time, are far more extensive still, as may be seen from the map (Pl. V) which I have constructed from those published by the American Government in the Annual Reports of the Entomological Commission.† It will there be seen that what is termed the "Permanent District" embracing the Rocky Mountains and a large adjacent territority from which the devastating locust is never absent, is about half surrounded by what is termed the "Sub-permanent District" from which they are seldom if ever absent, and that this again is partially surrounded by a

* *First Annual Report United States Entomological Commission*, 1877, p. 131.

† *Report of Commission of Agriculture*, 1877, p. 264, and *First* and *Second Reports Entomological Commission*, 1877-8-9, commencement of the vols.

very wide region termed the "Temporary District," extending from Lake Winnipeg in the North, almost to the Gulf of Mexico in the South, which is visited and devastated at times by flights of locusts. But in addition to this extremely wide central area, the Eastern States as far as Maine and Massachussets, which are upon the Atlantic coast, are at times visited by locust plagues, and the locusts occasionally also infest limited portions of the more westerly regions in America (*Report Commission Agriculture*, 1883, pp. 170–2.

"It is not to be inferred that the locust breeds continuously over the whole extent of the area each year,—as it is essentially migratory in its habits, and while it may deposit its eggs in a given river-valley, or in some favourable area on the plains lying about the mountains for a single year, or for several years in succession, it may desert its customary breeding ground for adjoining regions, or cross a low range of mountains, and breed in a more distant valley." "The true breeding grounds are for the most part confined to the river bottoms, or sunny slopes of upland, or the Sub-alpine grassy areas among the mountains, rather than continuously over the more elevated dry, bleak plains. In Central Montana, for example, the breeding grounds are known to be situated in the valleys of the Yellow-stone and other rivers, and the adjacent grassy plains or prairies bordering their tributaries. All these levels lie below an altitude of 5,000 or 8,000 feet and usually are not over 3,000 to 5,000 feet" (*i.e.* from about the summit of Snowdon to the summit of Ben Nevis). *First Annual Report Entomological Commission*, 1877, pp. 131 and 135.

"It is a common belief that this locust pest breeds in and comes from sandy desert countries. This is a mistake. The insect cannot live on sand, or thrive on Cacti or Sage Bushes," *Report*, 1877, p. 418. They breed chiefly in situations which will yield food for the young when hatched, and

it is the eventual failure of this supply which appears to be the cause of their moving off in swarms in search of food elsewhere.

"The State of Nevada affords no feeding ground for the locust, for the same reason that they do not breed in the greater part of Utah, viz:—the dry, hot, barren soil affording no grassy plains or fertile river-bottoms for the maintenance of extensive swarms of locusts. For the same reason Arizona and New Mexico are not the permanent abode of the Rocky Mountain locust."—*First Report Entomological Commission*, p. 133–4.

In districts covered with trees they seldom breed to any extent—this is attributed partly to the presence of birds which feed upon and destroy them, and partly to the absence of rich grass in ground covered by the dead leaves of Coniferous trees, or shaded from sun and air by the branches. Hence one of the important recommendations of the United States Government is that plantations of trees should be cultivated in the infested districts, and that locust-eating birds should be encouraged to multiply, and, if necessary, should be introduced from other regions, and encouraged to breed in the locust affected places.

The coloured maps published by the Entomological Commission exhibit these various features in great detail, and an attempt is made in the accompanying map (Plate V) to combine the teachings of the numerous American ones, so as to present the general impression to the reader; but the elaborate care bestowed by the Commission upon the production of their maps is beyond praise, and the result can only be very roughly represented here.

The Entomological Commission make this important summing up (*First Report*, 1877, p. 134–5). "The permanent breeding grounds of the Rocky Mountain locust comprise nearly all the available farming regions in the

immense area of the United States lying between the meridians 104° W. and 120° W. We shall be compelled to look squarely in the face the unpleasant fact that the sections in this area best adapted for agriculture, and especially the raising of grain, are those where the locust breeds in the greatest profusion. . . . On the other hand, the more that is done by farmers in the future in destroying the *young* locusts within this permanent area, the more likely will their combined efforts, carried on from year to year, tend to the ultimate destruction of the locusts. . . The more extensively this region is settled, the more will locusts diminish in numbers. It is then only a question of time, and of immediate effort on the part of the present generation of farmers."—*First Report*, p. 184-5.

The influence of cultivation upon the diminution of locusts is often strongly marked. *Ploughing* up the ground *where locusts have been seen the previous year* disturbs and destroys multitudes of the nests, and *harrowing it* where they have been seen previously on the *first appearance of the newly-hatched ones* is still more effectual, for as the egg-nests are only an inch or an inch and a half below the surface, the harrow brings them all into the air, by which the eggs are rapidly dried and killed (pp. 134-143). Harrowing can be performed much more easily and rapidly than ploughing, and the Commission lays more stress upon the importance of harrowing than of any other method of cultivation for the destruction of the egg-nests. When it is remembered that each nest on an average contains thirty eggs, the importance of their destruction need not be dwelt upon; and when the valuable manure that can be obtained from the dead locusts themselves (pp. 158-160) is borne in mind, the western farmer may possibly find that even the hatching of the insect plague is not an unmixed evil to a man of energy and decision.

### Devastating Species of North American Locusts.

The locust which is called *par eminence*, the "Rocky Mountain Locust," or *Caloptenus spretus* (Riley), is the one chiefly dwelt upon by the American Commission, as it is the most important from its numbers and its ravages. The "Lesser Migratory Locust," the *C. atlanis* (Riley), and the "Red Legged Locust," *C. femur-rubrum*, are distributed over a wider area, though in smaller numbers than *C. spretus*, and they are the devastating visitants of the Eastern States, U.S.

### Transformations of Locusts from the Egg to the Perfect Winged Insect.

The locust only lives for a single season, and dies soon afteı laying its last eggs. It has long been known that it undergoes various transformations between hatching and the perfect winged insect, but the number of the changes has been variously stated. It does not pass through any chrysalis period of prolonged rest, but until lately the actual changes do not appear to have been the subject of definite observation or experiment, and the accounts given in the *Reports of the Entomological Commission*, 1877, of a series of careful observations may therefore be briefly summarised as follows, the information being due to the joint labours of Prof. Riley, Mr. Packard, and Mr. C. S. Ninot.

The Egg is surrounded by a *thin*, *soft*, *moist* shell, which expands somewhat as the embryo approaches maturity; and being always moist and thin, it is readily shrivelled up by exposure to dry air, and the embryo may thus be killed. At the period of maturity the embryo fills the shell, which is so transparent that the antennae can be seen through it folded upon the face, and the legs folded upon the thorax, or lying bent up by the side of the abdomen (Pl. III, fig. 12).

The shell eventually opens by the anterior extremity bursting or coming off, and the remainder of the shell

splitting down the abdominal surface, the young locust or "LARVA" makes its escape, *Report* 1877, pp. 229, 279.

1st Stage. The "LARVA" when first hatched is white, and so soft and flaccid that for about a couple of hours it cannot stand, but lies upon its side. After this period it becomes of a speckled grey colour, about a sixth of an inch long, and is very voracious. The antennæ have twelve or thirteen joints, and it has no wings.

2nd Stage. The skin splits from the front of the face down the back, and with labour the still wingless "LARVA" drags itself out. Its colour is now darker, and its face is pitchy black. About a quarter of an inch long. No wings. Antennæ thirteen or sixteen joints.

3rd Stage. The same process repeated. Face darker still. About one-third of an inch long. LARVA has now barely the rudiments of wings. Antennæ sixteen joints.

4th Stage. Now called PUPA. About half an inch long. Antennæ lengthened by two or three additional joints. Two small rudimentary wings developing.

5th Stage. PUPA about three-fifths of an inch long. Wings about half the length of the abdomen. Antennæ further lengthened with two more joints.

6th Stage. PERFECT WINGED insect. Colours brighter. Antennæ with three or four additional joints (now twenty-three to twenty-six). Extreme length of body of female varies from 1·15 inch to 1·52 inch. Average about 1·32 inch. The male is somewhat smaller (p. 47).

They are voracious throughout, except for a few hours each time of moulting. These various stages apply to locusts generally, though the above particulars as to colour, size, and some other details, refer to *Caloptenus spretus*, the Rocky Mountain Locust. They are shewn in Plate III, copied from Pl. 1, *Report* for 1877.

### HOW THE EXPANSION OF THE WINGS IS EFFECTED.

The wings of Butterflies and Moths are folded up in the shell of the chrysalis, as those of the locust are folded in the last skin of the "PUPA," and it was long a matter of uncertainty in my mind as to the process by which the change was effected from a wing so small as to admit of being contained in such a small covering as the chrysalis shell or the pupal skin to the fully expanded organ of flight. Did the wing really grow with extreme rapidity after the perfect insect emerged from the shell, or was it of the full size while still contained in it? and, if so, how was the subsequent apparent increase effected?

Examination of a considerable number of butterflies and moths immediately after leaving the chrysalis, shewed that the wings were of the full size from the first, but were so soft and thin, moist and flexible, as to be easily folded into very small compass. The explanation then suggested itself that as the breathing tubes of an insect (Pl. IV, fig. 8) are present throughout the abdomen and thorax, and extend into the head and legs also, they were probably present in the wings as well; and that the insect, when shaking its wings, as it may be seen to do, shakes out the folds, and at the same time forces air along the air-tubes which constitute the veins of the wings. The wings would thus become distended and rigid like the fingers of an inflated glove, and the gummy moisture upon the wings drying up as they expanded and were fully exposed to the air, they would, when dry, remain blown up and perfectly rigid, and incapable of being folded again into the space they formerly occupied.

In order if possible to put the truth of this hypothesis to a conclusive test, I took off the wing of a small fly, which being transparent, could be put under the microscope. But that experiment failed to shew whether the veins were transparent and hollow or transparent and solid. I therefore

placed the wing in a glass containing some bright red tincture of cochineal, and weighting it sufficiently to prevent it from rising, put the whole under the air-pump. As soon as the exhaustion was commenced a stream of bubbles of air were seen to escape from the cut end of the wing, and on readmitting air to the receiver the coloured tincture was forced into the exhausted air-tubes of the wing, and on replacing it under the microscope the colour could be easily traced even into the minute veins—thus proving that they were extensions of the breathing apparatus of the insect, not perhaps now of any service for respiration, but of essential value by making the originally flaccid, folded, and useless wing into the expanded and perfect organ of flight.

### Locust Air Sacs assisting Prolonged Flight.

The expansion of the air-tubes into large air sacs throughout the head and body of the locust is illustrated in the drawing in Pl. III, fig. 9, copied from the drawings in the *Entomological Commission Report* 1877, p. 268.

From this it will be seen that a very large portion of the insect is simply a cluster of air-bags, which renders it unusually buoyant in comparison with other insects, and thus assists it simply to float in the air, and be carried by the wind without fatigue or exertion even for days and nights together in some instances.

### How soon do the Locusts acquire their Wings after being Hatched?

A large number of observations and experiments have been made and recorded by Professor Riley in America, with the result that the wings are acquired on the average in about ten weeks (average seventy-two days); but the actual period varies from rather more than eight weeks (sixty days) to nearly twelve weeks (eighty-two days) in an exceptional

case. The actual period in which they have acquired their wings (having been under observation the whole time) has been 72, 60, 70, 80, 70 and 82 days.

## Rising for Flight—Progress of Flying Swarms by Day—Influence of Wind.

"In *rising*, the insects generally face the wind, and it is doubtful whether they could ascend to any great height without doing so" (p. 268).

They are *carried* by the wind, and progress over the country tail first, only using their wings to keep themselves head to wind, like a boy's kite, in which position they are carried with the current of air.

"In alighting (to feed) they circle in myriads about you, beating against everything animate or inanimate, driving into doors and windows, heaping about your feet, biting and tasting everything, in seeking what they can devour. In the midst of the incessant buzz and noise which such a flight produces, and in the face of the unavoidable destruction everywhere going on, one is bewildered and dazed at the collective power of the ravaging host" (p. 266).

"If a passing swarm suddenly meets with a change in the atmosphere, such as the approach of a thunderstorm or a gale of wind, they come down precipitately, seeming to fold their wings and fall by the force of gravity, thousands being killed by the fall, if it is upon stone or other hard surface" (p. 266).

The Progress of the Flying Swarms depends on many circumstances, chiefly the character of the *wind* and the amount of food on the way.

"For the first two or three days, the newly-winged insects make short flights of a few yards, as if to try their wings. Then for a while they rise one by one higher in the air and float along with the wind, and, finally, when both

wind and weather are favourable, all that are strong enough rise as with a common impulse during the warmer morning hours after the dew has evaporated, and move off vigorously in one direction until they are soon out of sight" (p. 267, 268).

## Locust Habits at Night—Occasional Flight Night and Day.

"Their flight usually continues only until evening, when they generally descend, though in some cases they fly through the night as well as the day; and there is some reason to believe that when they first leave their breeding ground they do, occasionally, at any rate, continue their flight from necessity, the strong current of wind which is carrying them to more fertile regions being often more than a mile above the earth" (p. 269).

Their flight at night was, however, a matter of such doubtfulness that the experiment was tried of sending up a kite coated with tar, and it came down literally covered with locusts (p. 270).

A most convincing experience was that of Professor Aughey's. In camping on the Bow River, in August, 1866, the wind, which was blowing from the north-west, suddenly changed to north soon after *midnight*, and locusts were heard pattering on his tent, and they were thick upon the ground in the morning where none had been seen the day before (p. 270). Their occasional flight to ships hundreds of miles from land proves that they must at times be capable of long continued flight day and night (p. 270).

The insects seem to love warmth and shelter, for at night they generally huddle together under logs or brushwood, at the bottom of hedges or fences, or under any such shelter as they can obtain. As they become older this desire for shelter seems to increase, and it is made use of by

the farmers as one method for their destruction. All loose straw, small branches, and leaves, are collected together in convenient parts of the extensive fields, and during the night are set on fire, and in this way multitudes of locusts are destroyed. During the first few days after they have acquired their wings they seem to prefer more elevated situations, and delight to roost away from the ground, especially in trees (p. 276).

### Destructive Power of Locusts.

"The day breaks with laden orchards and promising fields, and all the earth seems glad. Suddenly the sun's face is darkened, and clouds obscure the sky. The joy of the morning gives way to ominous fear. The day closes, and ravenous locust swarms have fallen upon the land. The morrow comes, and what a change it brings. The fertile land has become a desolate waste, the sun shines sadly through an atmosphere alive with *myriads of glittering insects*, and in a few hours they convert the green and promising acres into a desolate stretch of bare spindling stalks and sticks" (*Report of Agriculture*, 1877, p. 265) "Covering every hill, they sweep clean a field quicker than would a whole herd of hungry steers. Imagine hundreds of square miles covered with such a ravenous horde, and one can get some idea of the picture presented in many parts of the country during years of locust invasion," p. 266.

The following are a few of the reports from the devastated districts (*First Annual Report*, p. 117). "The crops are all destroyed, together with the pastures and meadows, and the country would present the appearance of winter were it not for the leaves on the *timber* trees; all the leaves are stripped off the *bushes*," p. 117.

Again, "Our once beautiful flower-flecked prairies now look as desolate and barren as the desert," p. 117.

Another, "Imagine every green thing eaten entirely up, and the meadows and pastures as bare as the centre of a well-travelled high road, and you can form some idea of our condition," p. 117.

And again, "The grasshoppers have eaten up all the flax, and the wheat and corn, and now they are attacking the grass, and three weeks hence will witness a country as barren as the grim deserts of Africa," p. 117.

So far for recent American descriptions.

"The land is as the Garden of Eden before them, and behind them a desolate wilderness; yea, and nothing shall escape them" (Joel, ii. 3) is the graphic description by the prophet Joel in his time; which does not require the change of a word to represent the locust smitten regions of North America at the present day.

### Farmers' Losses by Locusts.

The Total Loss in the four years 1874–5–6–7 from locust plagues in the United States of America is estimated to have been "not less than $200,000,000"; * or £40,000,000; or £10,000,000 yearly;" an amount of injury which the average non-statistical mind is incapable of realising. But when we find that it would amount to a yearly income tax of 7d. in the pound upon the whole of Great Britain and Ireland, we can more easily grasp the suffering which this locust plague inflicts, year by year, upon our friends and neighbours in the United States of America.

### Noise of the Jaws at Work.

"The noise their myriad jaws make when engaged in this work of destruction can be realised by any one who has 'fought' a prairie fire, or heard the flames passing along before a brisk wind."—*Report* 1877, p. 214 (Pl. III, fig. 11).

* *First Report*, p. 122.

It is interesting to notice how singularly this description tallies with that given by the prophet Joel of the locust plagues in Palestine in his own time—"Like the noise of chariots on the tops of mountains shall they leap—*like the noise of a flame of fire that devoureth the stubble.*"—(ii. 5). The ancient prophet describes the *sound,* and the modern philosopher describes it in almost the same words, but assigns "their myriad jaws" at work as its explanation.

## Where the Eggs are laid and their Tenacity of Life.

The eggs are laid almost any where except in *loose* sandy drifting soil, or in very barren places. Cultivated or grassy ground, clay banks or hill sides, or moist hollows in valleys are preferred, as they furnish food for the young when hatched. The female locust drills a hole in the ground about the third of an inch in diameter, and an inch or an inch and a half deep (Pl. IV, fig. 1), with the hard cartilaginous plates at the extremity of the body (Pl. III, figs. 9, 10), and lines it with a mucous secretion which soon dries and hardens. She then lays about thirty eggs on an average, and closes the mouth of the nest (always called a "cocoon") with more of the mucous and leaves it. Dust soon covers and partially or entirely conceals the nest from view. The process occupies about three hours if she is undisturbed, and while it is sometimes said that the female only lays one set of eggs, it has been established by American observation that she often lays twice, and generally three times, in the season (*First American Report,* 1877, p. 288), after which she soon dies. If disturbed while making her nest she leaves it unfinished, and any eggs deposited in it dry up and are spoilt. Mr. Brown, in 1883, has counted as many as 420 cocoons in a single square yard of ground in Cyprus, the average number

being 137 per square yard, but Professor Riley, in America, has found them in much greater numbers, amounting to nearly a thousand cocoons in the square yard.

The nests are discovered by watching the neighbourhoods where the locusts are laying, and scratching the earth to a depth of about an inch, or by harrowing up the soil in the spring on the first appearance of the young newly hatched locust.

As a rule, the locusts avoid light, shifting, sandy soil, as the nests are then very liable to be uncovered by the wind, and the eggs are thus exposed to the drying action of the air, which shrivels them up through their thin moist shells, and appears to be almost the only natural climatic agent that kills them. As a rule, swamps are avoided, but there are numerous instances, both in America and in Cyprus, in which the young locusts have appeared in ground that has been swampy and not suspected of harbouring them, and Mr. Brown mentions (p. 4, 1884), having seen numbers hatched from the dry beds of what throughout the rains had been pools, and his attention was called so late as near the end of April to young locusts hatched that day in the bed of the river Idalia, which had been covered by water for four or five months.

The fact is that neither water nor a considerable degree of frost kills the eggs, though they may retard the period of hatching, which appears to depend chiefly on the mean temperature of the soil (Brown's Report, 1884, p. 5). A series of experiments on the influence of frost upon the locust eggs was tried by Professor Riley, of America, in which he found that they might be warmed artificially for some time even in the beginning of winter up to the point at which some of them hatched. The remaining unhatched eggs were then exposed to frost for periods varying from a single week to some months and no further hatching occurred until they were

EXPERIMENTS TO ASCERTAIN THE INFLUENCE OF ALTERNATE FROST AND WARMTH UPON THE VITALITY OF LOCUSTS' EGGS.

| | Egg masses. | Exposed to frost. | Taken into Artificial Heat at 65° to 70° F. | Commenced hatching after |
|---|---|---|---|---|
| Exp 1. | 50 | Nov. 10 to Jan. 10. | January 10. | 20 days. |
| ,, 2. | 58 | All November to Dec. 10. | December 10. | 21 days. |
| | | Some remaining unhatched were again exposed to frost on Jan. 10. | The weather being unusually mild, they now hatched out of doors in the ground every warm day. | |
| ,, 3. | 50 | Exposed for some weeks. | December 1. | None hatched. |
| | | They were again exposed to frost for three weeks. | January 12. | 2 to 17 days. |
| ,, 4. | 100 | Exposed to frost every alternate FORTNIGHT. | Brought in every alternate FORTNIGHT. | Some hatched during the 2nd period indoors, the rest in the 3rd period. |
| ,, 5. | 100 | Exposed every alternate WEEK. | Brought in every alternate WEEK. | None hatched during the first three periods indoors Began to hatch in the 4th period up to the 7th. |
| ,, 6. | Many hundreds. | All the winter. | Not brought in at all. | March 2 to April 9. |
| ,, 7. | Many hundreds. | Not exposed at first. | In the warm room all the time. | Nov. 28 to Dec. 15. |
| | | Then exposed Dec. 15. | | Hatched whenever the weather was warm. |
| ,, 8. | 100 | Not exposed. | In the warm house all the time. | November 19 to January 15. |
| | | Rest, then exposed January 15. | January 28. | Hatched up to Feb. 10. All hatched by that time. |

again brought into a building at a temperature between 65° F. and 70° F. when they again freely hatched, and on examination it was found that all the eggs had retained their vitality, and had eventually hatched. (*First Report Commission Agriculture*, 1877, p. 284–5).

Thus it appears that the eggs may be constantly frozen for weeks, or may be alternately frozen and thawed, or they may be warmed up to the point of hatching, and then frozen and again warmed to the hatching point, and the eggs still retain their vitality, and none of them are killed by the changes of temperature. It is noticeable also that, whilst birds' eggs if sat upon until upon the verge of hatching, are then deprived of heat by neglect, they become addled; but this is not the case with the locust eggs, which were warmed in many of these experiments until they were hatching day by day, and at this stage the still unhatched ones were frozen for days or weeks, but so far from becoming addled, they hatched readily, either in artificial heat, or on the advent of natural warm weather.

The tenacity of life in these eggs is indeed remarkable, for a number were hatched on exposure to warmth, which had been buried one foot deep for FOUR YEARS, and were then only discovered in making the foundations for the Agricultural College, at Manhattan in Kansas. (*American Naturalist*, vol. 15, 1881, pp. 749 and 1,007. H., 1870, Liverpool Free Library).

### TIME OCCUPIED IN HATCHING.

With favourable conditions of soil, and a temperature of 85° F., the eggs will hatch in from four to five weeks, and in a temperature of 75° F., in six weeks; but in some exceptional *experimental* cases observed by Professor Riley, from twenty-one to thirty days sufficed. (*First Report*, p. 232).

### Date at which the Eggs Hatch Naturally, and the Time when the Young Locusts may therefore be looked for.

This varies from January to June, according to the weather.

In very mild weather some hatch in January or February, but they are killed by the subsequent cold in March and April.

The eggs laid earliest in the year hatch the earliest next year; and as the period of egg-laying occupies from six or eight weeks in the same locality, some of the eggs pass the winter quite fluid, while others are ready to hatch the first warm day.

The bulk hatch :—

In Texas, which is very warm, from the middle to the end of March.

,, South Kansas, warm, second week in April.

,, North Kansas, and Iowa and Nebraska, cooler, end of April.

,, Minnesota and Dakota, colder still, first three weeks in May.

,, Montana and Manitoba, still colder, last two weeks in May.

From this experience a very important practical rule has been deduced for the guidance of farmers in the infested regions.

Rule.—In lat. 35° they hatch in the middle of March, and *four days later for every degree of lat. North up to lat.* 49° N, where they practically cease. Hence the farmers can be warned when to expect the locusts to hatch in their particular neighbourhood, the Government inspectors telegraphing that "locusts have hatched in such and such a place," and they must, therefore, be looked for, and the necessary provision made for their destruction in "so many days,'" according to the distance northward to which they are sending the news.

## The Beauty of Locusts.

We are so much in the habit of associating destruction and terror with a flight of locusts, that it scarcely occurs to us to think that they can be beautiful, yet the drawings upon the screen, and the locusts from the Liverpool Free Museum, shew no lack of beauty in the rich crimson and the delicate green of their transparent wings, or in the golden and purple colours reflected from some of them. But the following extracts from two modern writers bring their beauty, when seen in swarms, vividly before the mind; and the contrast between the impression of their beauty on the one hand, and the gloom they produce on the other, is not undeserving of record.

In a lively series of Sketches of Eastern Scenes, by Phil. Robinson, the following description occurs of an unexpected flight of locusts :—*

"A bare plain, dotted with tents, the camp of our gallant little Ghoorkas, stretches away towards Shikarpur. . . . While looking at it [a tower one hundred feet high], I became aware of a cloud in the sky such as I had never seen before. It was of a *transluoent brown, flushed at the edges with pink, and glittering with an infinite multitude of twinkling points.* It was moving towards me with great rapidity. What was the wondrous, solid thing that, widening out, threatened to overshadow the whole landscape, and was *instinct with little sparkles of light?* It was only a mile or so off, and the shadow of it lay dark upon the Ghoorkas' tents. Then all of a sudden I heard the multitudinous fluttering of tiny wings, a noise as if the cloud was crackling with electricity. Then, lo! with a rush of an infinite host there swept down out of the sky the myriad scourge. It was a flight of locusts—"the armies of Allah," as the Arab calls them.

"The whole air was rustling with the sound of their crisp wings—and the colours of them! *The underwings of the locusts are tinged with pink, and the sunlight shining through them made rosy splendour.* But

* *The Special at Large*, p. 47, Phil. Robinson. *Indian Garden*, Series No. 1. Sampson Low, Marston & Co., 1884.

when they were in mass the cloud was a deep chocolate, and the ground was dark beneath them as they flew.

"In a few minutes the tents had utterly disappeared. The plain was a uniform brown, not a speck of any colour was to be seen. *But the Ghoorkas were in the wildest delight, for they eat locusts*, and it was a sight to see when the whole regiment turned out as one man to catch the insects, scraping them together into heaps, sweeping them up into piles. Then in an hour the sun was below the horizon, and the locusts, at rest for the night, lay in an unbroken carpet over the land."

In the *Voyage of the Sunbeam*, Mrs. Brassey says, pp. 79, 80:—

"Carcarañа, Argentine Republic, (near Rosario).

"Our road lay through a desolate looking district, bearing too evident signs of the destructive power of the locust. . . . A week ago the various crops were a foot high, but in a few hours the industry of the last ten months was rendered utterly vain, and the verdant fields converted into a barren waste. . . . *for six hours in the middle of the day it became absolutely necessary to light candles owing to the dense clouds of locusts, about a league in extent, by which the air was darkened.* Trains are even stopped by these insects occasionally, for on the lines their bodies make the rails so greasy that the wheels of the engines will not bite. Moreover, they completely obscure the lights and signals, so that the men are afraid to proceed. The only remedy is to go very slowly, preceded by a truck-load of sand, which is scattered freely over the rails in front of the engine . . . as the locusts passed between us and the sun they completely obscured the light. *A little later, with the sun shining directly on their wings, they looked like a golden cloud, such as one sometimes sees in the transformation scene in a pantomime; and at a greater distance, when viewed from the top of a slight eminence, they looked like a snowstorm which had suddenly taken wings.*"

A letter from a relation of my own, whose crops were destroyed in Minnesota for three years running, thus describes the approach of the swarm:—"It might have been a hailstorm; it was not an opaque cloud, but a *shim-*

*mering cloud that dazzled* and prevented us from seeing any distance."

"Their flight may be likened to an immense snowstorm, extending from the ground to a height at which our visual organs perceive them only as *minute darting scintillations*, leaving the imagination to picture them infinite distances beyond. On the horizon they often appear as a dust tornado, riding upon the wind like an ominous hailstorm, sweeping up to you and past you with a power that is irresistible" (*Report Commission on Agriculture*, 1877, p. 266).

### Height of Flight above the Earth.

"There is no doubt whatever that the insects often move over a country *entirely above the reach of human vision.* In ordinary flights only the lower insects can be seen, and in looking towards the sun we may always observe others, further and further away, until *the glittering specks* are lost to sight. In cloudy weather the flights are not noticeable, (unless they are so dense as to darken the atmosphere), until they are within about a thousand feet (about half the height of Skiddaw), yet it is well known that they fly at times nearly, if not fully, from two to three miles above the earth; for they have been seen flying towards the plains so high above the highest peak of the Rocky Mountains (14,000 or 15,000 feet above the sea) that only a good telescope could distinguish them as flying insects" (*Report*, 1877, p. 219).

### Rate of Progress of Flying Swarms.

When the flying swarms do fairly start their rate of daily progress varies considerably, depending chiefly upon the velocity of the wind, but in part also upon the amount of food they meet with to delay them on their route. The experience of four years in America shewed that they travelled forward about twenty miles per day on the average,

though this rate of progress is often exceeded. In a case which came personally under my knowledge through a relative in Minnesota, the locusts were reported as being at Milwalker, which was a hundred miles distant, and in the afternoon of the second day the alarm was given that they were approaching. They slowly settled, and the next morning on going to look at the fields, which were covered with beans eighteen inches high and in full pod the day before, they were all beaten down and almost entirely eaten up, and "we were nearly smothered by the quantity of grasshoppers that rose up and quite hurt our faces as they flew against them. They had real faces, sticking out eyes, and you could hear them eat. They stayed till they had eaten all our crops, and then, when a fair wind came, they rose like a cloud and went away."

During this period they had laid their eggs in such numbers that in Spring of the following year, 1874, the ground was alive with the young black hopping locusts, which were about a quarter of an inch long when first seen.

In the early part of the season, when in their fullest vigour and power of flight, the main swarm seldom remains more than two or three days, leaving only a few stragglers behind; but later in the season they remain much longer, being then occupied in laying their eggs and having apparently less vigour for renewed extensive flight.

But though the flying swarms have disappeared after suddenly producing the devastation of the country, the plague they leave behind is scarcely less destructive, for in the following year, before the time arrives for fresh swarms, the ground and everything upon it is black with the young locusts newly hatched from the eggs left the previous year, and they devour every green thing slowly and ravenously.

As a rule, the locusts which thus hatch from the swarms of the previous year disappear by flight before the new

swarms arrive from their permanent breeding grounds in the Rocky Mountains. In the more northerly parts (Minnesota and Manitoba) the locusts hatched upon the ground acquire their wings about the end of June. While further south, as the climate becomes gradually warmer, they hatch earlier, and in Southern Texas they are able to fly as early as in April. On the other hand, the invading swarms from the Rocky Mountains naturally arrive latest in the parts most distant from the mountains, and in their recorded progresses the new migratory swarms have appeared in the following order:—

Southern Dacota, in June.
Colorada, Nebraska, Minnesota, early in July.
Iowa and Western Kansas, late in July.
South-east Kansas and Missouri, during August, and
Dallas, in Texas, not until the middle of October.

### Rate of March of the Unwinged Locusts.

In America their rate of march has been carefully examined, and it does not exceed three yards per minute, which is scarcely a mile in ten hours, for they feed as they march in many cases, and their mode of motion is a sort of *trois-temps* step—one hop and two steps. They seldom take two hops in succession, and if they are made to take ten or a dozen hops one after the other they are quite exhausted. The swarms that breed in one year from the eggs left behind the previous year in the regions that have been devastated, seldom travel as much as thirty miles during the whole of the eight or ten weeks between being hatched and gaining their wings; and when they have acquired their wings, they then generally return as flying swarms to the Rocky Mountain regions, from which their parents originally set out. They seldom lay eggs in the temporary regions, and such as are laid seldom hatch, or if they do the offspring are

poor decrepid locusts. In some parts of the Continent of Europe they are said to have marched as much as one mile per hour instead of a tenth of a mile only, but the accuracy of these observations is doubtful.

## Locust Enemies.

While the locusts produce such devastation to cultivated crops, and are thus such enemies in many cases to the human race, they themselves furnish support to innumerable other living beings, which find them not only nutritious, but, we may presume, palatable also.* Of these it will be impossible to enumerate more than one or two in detail, but the two kinds of insects which are shown in the drawings (Pl. IV) have been selected as illustrating the patient care which Prof. Riley, and the other naturalists in the service of the American Government, have devoted to the study of whatever bears upon the subject of locust history.

The first is called the "Digger Wasp" (Pl. IV, fig. 7), because of its habit of digging a hole in the ground by means of its strong beak, in which it lays its egg, and then leaves it to hatch. In order to make this hole it has sometimes to remove stones of considerable size and weight compared with the insect itself, and having done this, it then proceeds to make a provision for its future little hopeful. It attacks some insect, as shown in the drawing (Pl. IV, fig. 7), which is copied from one by Prof. Riley, and appears to deposit some fluid which paralyzes its victim. It then carries or drags away its helpless prey, puts it carefully into the hole, and then lays an egg in close contact with it, and bids it good-bye. In course of time the egg hatches, and has no sooner

* Pigs will eat them greedily, and in the discussion of this paper Surgeon-Major Black said that in South Africa the horses when they see locusts at a little distance will turn out of the road in order to devour them, in spite of bit or rider.

done so, than it finds a bountiful supply of fresh meat ready to hand upon which it feeds until it is able to leave its parental home, and commence the great business of life,* which appears to be obtaining its own living without too scrupulous a regard for the rights or feelings of others. An illustration perhaps of the theory of heredity as applied to human affairs.

The next illustration is one which required great patience and watching for its elucidation. It is the *Red* or *Silky Mite*, which is sometimes in such numbers as to make the ground over large spaces red or orange in its colour. This creature is really a *Mite*, about the size of a very small pin's head, but its indescribable numbers render it a formidable enemy to the locust. The mature insect has *eight* legs, in which respect it differs from its offspring, which has only *six*, and this difference for a long time led naturalists to suppose them to be different insects instead of merely different stages of the same creature. The female lays her numerous eggs (200 or 300) in the ground, about an inch below the surface, in the neighbourhood of locust breeding grounds. When they hatch they are not so large as a very small, almost microscopical pin's head; but they are very active for such little fellows, and with their six legs they attach themselves to a locust's nest, through the cover of which they work their way, and then suck one egg after another until the whole are destroyed. The destruction from this and other insects feeding upon the eggs is so great, that when Mr. Brown made a careful examination of the egg nests in Cyprus one spring previous to the hatching season, he found that nearly one-half (forty-six per cent.) of the cocoons were empty (*Report Locust Campaign*, 1884, p. 5); the cases remained, but the eggs were all gone.

If, instead of the eggs being attacked, there are winged

* *Ann. Rep. Ent. Com.*, 1877, p. 317.

or travelling locusts at hand, the active little mite-grub fixes itself in some convenient sheltered place, generally the arm-pits of the wings (if we may so call the situation) or at the junction of two veins in the wings, and there it sucks the locust juices until it becomes a close representation of "Greedy Sam," as shown in the drawing (Pl. IV, fig. 4). While thus feeding it is also developing, and when removed from its attachment its eight legs and its antennæ may be seen. Its skin then bursts, and it issues forth the fully developed mite, with eight legs like its parent (*Ann. Rep. U.S. Entom. Com., Rocky Mountain Locust*, 1877, p. 309).

Of the destruction of locusts by the various birds which feed upon them a vivid description is given by Canon Tristram in a recent paper of his journey through Syria in 1881 (*The* "*Ibis*," 1882, p. 418) :—

"Once we came on a patch of some acres which had recently been visited by locusts. The old locusts were gone, but the young, not more than a quarter of an inch long, made the ground literally alive. They rose at every step of our horses like sand-lice on the sea-shore from a piece of seaweed left by the tide. Just after we had passed through this patch of devastating flight, I turned my head and saw a great globe in the air. It suddenly turned, expanded, and like a vast fan descended to the ground We waited a few minutes, and saw acres covered with a moving black mass, dappled with pink. In a short time the mass became restless, and we rode back. The birds rose quietly, but not till we were close on them, and only those within dangerous distance. But not a young locust could we see. The 'Pastor' had well earned its name of the 'Locust-bird,' and one batch of foes to man and his labour had been promptly and for ever exterminated." (This bird, the "Pastor," is in the Liverpool Free Museum.)

## Locusts as Food.

The instance of locusts being used as food which is best known to most Europeans, is the statement that John Baptist's food was "Locusts and wild honey." It is difficult to understand how any doubt could have arisen upon

this point, for the word used in the Greek Testament is "akrides," "ἡ τροφὴ ἦν ἀκρίδες και μελι αγριον," the common Greek name which has never ceased to be applied to the locust insect. Locusts are scarcely ever absent from the wilderness on the banks of the Jordan; and in many parts of the East, the Arabs, who are not farmers, and therefore do not suffer from their devastation, regard them with delight, as a luxury. They roast them, after which the wings and legs are easily rubbed off, and then fry them in butter if they have any, and eat them. They taste like shrimps, but have rather less flavour than our favourites of that name. If they desire to keep them for a future provision, they dry them thoroughly until they can be powdered, then mix them with salt, and press them into a cake, which will keep for a considerable time (*First Rep. U.S. Com.*, p. 437 to 443).

The North American Indians, between the plains and Sierra Nevada, eat them after baking them in holes in the earth heated by hot stones and covered with hot sand. Some of them powder them along with pounded acorns and berries of various kinds, and press them into cakes which they dry for future use. Mr. Packard, one of the four Commissioners of Agriculture of the United States, says "that he has eaten them prepared in various ways, but cannot say he has found them very palatable. But they must be nourishing, for the poor people thrive wonderfully on them," which is not surprising when we look at Mr. Davies's analysis (see page 159), and see the amount of nitrogen they contain. The Bushmen of South Africa catch them by lighting fires in the path of their swarms. As the insects pass over the flames, their wings are scorched, and they fall helplessly to the ground. They are also collected by cartloads after they have retired to roost for the night and before they can shake off the dew from their wings, which prevents their flight in the early morning.

The most complete evidence is, however, given by Prof. Riley in his *Report to the American Assoc. for the Advancement of Science*, in 1875.

Locusts and grasshoppers are among the "clean animals" that are sanctioned in Leviticus, and among the Nineveh sculptures in the British Museum are represented men carrying to a feast locusts suspended from sticks along with other kinds of food.

Pliny says they were much esteemed among the Parthians, and among the nations in the South of Europe and Asia; and in Morocco they are now eaten to such an extent that when they are present other forms of food are brought to market in reduced quantities. In Tangiers, and other towns, they are habitually roasted and brought for sale in the public markets by the country people, and Radoszkowski, the President of the Russian Entomological Society, says they are extensively used as food in Southern Russia.

The various modes of cooking them all begin with taking off the wings and legs, after which the bodies are roasted, boiled, stewed, fried, or broiled. In most parts of Africa, and in Russia, they are salted, or smoked like red herrings. The Moors first boil and then fry them; but the Jews of Morocco salt them and use them for flavouring their usual Saturday dish, called *Dafinia*, which consists of meal, fish, eggs, and tomatoes, etc., which are put together into a jar in a hot oven on Friday night, and thus kept warm through the Sabbath, without their having to cook their meal on that day.

Professor Riley had long wished to test the quality of locusts as food on the quiet, for he knew that any open proposal to do so among the American or European settlers would excite ridicule or disgust. But the invasion of locusts in Kansas and Nebraska, in 1874, had brought so many of the settlers to the brink of the grave from famine, that he

had a weighty reason for trying the experiment. He therefore ate them cooked in different ways, and for a time took no other diet, and commencing the experiment with some misgivings he was agreeably surprised to find that they were quite palatable in whatever way prepared. The flavour of the locust when raw is strong and disagreeable, but when cooked in any way it is agreeable and sufficiently mild to be easily disguised by any kind of flavouring or sauce. But the great point that he urges in their favour is that they really do not require disguising or flavouring, and that the cooking may be of the simplest character, whilst they are a most nutritious article of diet.

A broth made by boiling the unfledged locusts for two hours, and seasoning it with nothing but a little pepper and salt is quite palatable, and *scarcely to be distinguished from beef broth.* The addition of a little butter improves it, and sage, mint, &c., can be added at pleasure. Fried or roasted in nothing but their own oil, with a little salt, they are not at all unpalatable and one soon gets to like their slightly peculiar flavour. "The mature insects with the wings, heads and legs removed, first boiled, and then stewed with a few vegetables, and a little butter, pepper, salt, and vinegar made an excellent fricassee."

He sent a bushel of scalded locusts to one of the oldest and best known caterers of St. Louis, and, (master of the mysteries of the cuisine) Mr. Bonnet made a soup which was really delicious, and was so pronounced by dozens of St. Louisians who partook of it; and Mr. Bonnet declared it reminded himself of nothing so much as craw-fish *bisque*, a dish much admired by connoisseurs. He said he would gladly have it on his bill of fare if he could get a regular supply.

Mr. C. Horne, F.Z.S., writing to *Science Gossip*, says he invited some friends to dinner, and gave them a curry

and croquette of locust, which were pronounced excellent, being supposed to be *Cabul Shrimps*. Unfortunately the cook had left a hind leg in the croquette, which like the memorable button in Sam Weller's sausages revealed the truth, and one gentleman retired from the party disgusted, and the rest highly amused.

African locusts, prepared in various ways, have been used as bait for the sardine fishery, and possess many advantages in cheapness and attraction for the sardines. (*First Report*, p. 441).

### Fertility Produced by Dead Locusts.

"After the insects have left, the ravaged country begins to wear a bright and promising aspect, in strong contrast with the desolation of a month before; and frequently the finest crops of corn, Hungarian grass, buck wheat, and vegetables of all kinds are grown. Root crops do well, and vegetables attain immense proportions, owing to the freedom from weeds, and the fertility resulting from the bodies of the dead locusts." (*First Report*, p. 433).

"The unusual productiveness of the soil in the stricken country was on all hands noticed during the year 1875, and was owing in no small degree to the rich coating of manure which the locusts left in the form of droppings and dead locusts in the spring in the best condition to be carried into the soil and utilized there" (p. 433).

If the valuable manure from the pits full of dead locusts was only utilized it might materially mitigate the desolation produced by the living ones.

### Value of Locusts as Manure.

The enormous destruction of these insects in a single year in Cyprus (about 15,000 cart loads, p. 127), and the number annually destroyed, or to be destroyed in America, raises

the question whether some use cannot be made of such an amount of dead animal matter, and Mr. Edward Davies, F.C.S., F.I.C., lately our President, has kindly analyzed a number of locusts, both winged and in the pupa state, sent to me by Mr. Brown from Cyprus. They had to be dried before analysis, as they came preserved in spirit, and the following is the result:—

MR. DAVIES'S ANALYSIS.

| | Locusts without wings (Pupa). Per cent. | Wings developed. Per cent. |
|---|---|---|
| Phosphoric Acid ($P_2O_5$) ... ... ... ... | 1·92 | 1·89 |
| = to Tribasic Phosphate of Lime ... ... | 4·21 | 4·18 |
| Nitrogen ... ... ... ... ... ... ... | 10·14 | 10·62 |
| = to Ammonia ... ... ... ... ... ... | 12·31 | 12·92 |

"This dry material is as rich in nitrogen as meat, guano, or dry blood, and contains enough phosphoric acid to increase its value. It is worth at least £5 per ton." (Ed. Davies, F.C.S., F.I.C., &c.) This analysis relates to locusts dried after being preserved in spirit, and I have not been able to find any analysis of locusts in their native condition, or any other analysis except that of "the juices of the locust," obtained by pressure, which was made by Professor W. K. Kedgin, State Agricultural College, Manhattan, Kans., and is published in the *First Report Entomological Commission*, p. 441–2.

ANALYSIS OF THE JUICE PRESSED OUT FROM THE BODIES OF FRESH LOCUSTS.

| | Per cent. |
|---|---|
| Water ... ... ... ... ... ... | 87·083 |
| Oil ... ... ... ... ... | ·004 |
| Solid Organic Matter ... ... ... ... | 12·903 |
| Mineral Ash ... ... ... ... ... | ·010 |
| | 100·000 |

ANALYSIS OF THE "MINERAL ASH" SHOWED—

| | Per cent. |
|---|---|
| Phosphoric Acid ... ... ... ... ... | 50·713 |
| Lime, Magnesia, Potash, Soda ... ... ... | 34·274 |
| Sulphuric Acid and Chlorine ... ... ... | 2·913 |
| Silica .. ... ... ... ... ... | 12·100 |
| | 100·000 |

## ALLEGED STENCH FROM DEAD LOCUSTS.

The accounts of the horrible and sometimes deadly stench from the bodies of dead locusts, given by various ancient writers, produce an impression that there must be something exceptionally offensive and injurious in these insects when dead. The *Reports on the Locust Campaign in Cyprus* do not, however, allude to this point, and I therefore wrote to Mr. Brown on the subject, who replied that the smell, so far as his experience went, was not worse than that of any other dead animal matter, and he had never heard of any sickness resulting from it. The American *Reports*, likewise, make no allusion to any specially offensive or dangerous odour proceeding from these insects when dead upon the fields, and it would therefore appear that the descriptions of plagues, resulting from the deadly stench that might be perceived miles and miles away from the dead locusts, only apply to those exceptional cases in which swarms of unusual magnitude have lain dead upon the sea beach in tropical or semi-tropical climates; and that any peculiarly offensive or dangerous odour is the rare exception, and not by any means the rule.

## THE METHODS OF DESTRUCTION RECOMMENDED BY THE AMERICAN COMMISSION.

The various methods adopted or recommended in America occupy nearly a hundred pages of the *First Report*, and are illustrated by numerous plates, exhibiting almost every form

of apparatus in use, *except the plan invented by Mr. Matte which has been so successful in Cyprus*; but it would be impossible to attempt in a paper like the present to describe the numerous mechanical contrivances adopted in America.

## On the Connection between Sun-spots and the occurrence of Locust Plagues.

An interesting paper on this subject by Mr. A. H. Swinton, Guildford, Surrey, England, is published by the Commission in the *Third Report of the Entomological Commission*, 1880–2, p. 65. It contains elaborate tables and statistics to illustrate the connection in point of date between the occurrence of sun-spots and of locust plagues, and it concludes as follows (p. 85):—"The weather is the cause of insect multiplication; the weather in consecutive years differs alone (virtually) on account of changes in the sun's photosphere. . . Properly generalised observations show almost invariably an exact concordance between *sun changes* and *these effects*" (*i.e.* temperature, magnetic deviations, rainfall, famine, epidemics, &c.) The practical lesson to be drawn from the paper is that it may be possible to infer the probable occurrence, or the probable absence of locust plagues, and therefore to adopt the necessary precautions, say, in the present season from the solar phenomena of the past year, or for the coming season by the sun's spots of the present year. The verification of the theory or its disproof is a subject requiring careful and continued observation, and the paper itself raises a presumption in favour of such attention being deserved.

## Modern Locust Visitations in Europe.*

Locust invasions have been recorded in Germany since A.D. 1333. In 1478 the country about Venice was invaded,

* *Report Entomological Commission* 1877, p. 467.

and in 1725 the region about Rome was overrun by locusts. They are constant visitants in Malta, but they seldom remain any length of time, and they are not very destructive. In France swarms appeared at the close of the middle ages, and they still occasionally visit the south of France.

In Russia the southern steppes are the *home* of the locust. Vast swarms visited Bessarabia in the time of Charles XII., coming from the Black Sea borders. Russia, Poland, Hungary, and Austria were overflowed by them, and they then divided into two swarms, one of which flew south into Italy, the other into France, Bavaria, and Saxony. In 1828 and 1829 enormous swarms invaded the coast of the Black Sea, and the south Russian province of Cherson in 1859. In 1873–4 small swarms appeared about Genshagen near Berlin, where they laid eggs from which millions of locusts were hatched the following June. In 1875–6 Spain was seriously invaded by them, and the Cortes voted a large sum to enable the Government to take measures for their destruction. The military were called out to assist the people, for thirteen provinces were threatened with the plague.

England has been visited on two occasions, in 1693 and 1748—but the locusts soon died, and appear to have laid no eggs. There are recent specimens of our native locusts in the Liverpool Free Museum, but they are never sufficiently numerous to be injurious in this country.

## DESCRIPTION OF PLATES.

Plate I.—Map of Cyprus, showing the parts infested with Locusts (shaded) and those parts free from them (unshaded).

Plate II, Fig. 1.—General view of the screens in position, stretched in front of an advancing horde of Locusts, and the pits at short intervals.

Fig. 2.—Detailed view of two pits and screens, with measurements added.

Fig. 3.—Plan A.—Horizontal section of pits, with the overhanging zinc plates in position, and the dimensions.

Plan B.—Cross vertical section, showing the mouth contracted by the zinc plates, and the dimensions.

Plan C.—Longitudinal vertical section, showing the screen and zinc plate, and the dimensions.

Plate III.—Locust transformations and special anatomical portions.

Figs. 1, 2, 3, 4, 5.—Lateral views of the Locust in its Larval and Pupal stages. 1, 2, 3, LARVAL without wings. 4, 5, PUPAL with rudimentary wings.

1*a*, 2*a*, 3*a*.—Back views of Locusts. Larva. No wings.

4*a*, 5*a*.—Ditto PUPAL state. Wings developing.

Fig. 6.—Last skin cast previous to the perfect winged stage.

Figs. 7, 8.—Perfect insect, with the wings folded and expanded.

Fig. 9.—Lateral view of the air bags in the flying Locust. *a*, *b*, air bags in head. *c*, *c*, air bags in abdomen.

Fig. 10.—Cartilaginous plates at extremity of abdomen, to assist in making the "cocoons" and laying the eggs.

Fig. 11.—The two mandibles or jaws.

Fig. 12.—Side and under view of the egg immediately before hatching, showing the legs, &c., through the soft transparent shell.

Fig. 13—A, B, C, D.—Comparative size and appearance of the Locust at different ages. A, two hours old. B, two days' old. C, early LARVAL stage. D, last PUPAL stage.

Plate IV, Fig. 1.—Female Locust depositing her eggs, and a "cocoon" filled and its mouth closed (p. 142).

Fig. 2 —"Red" or "Silky Mite" laying its eggs (see pp. 153, 4).

Fig. 3.—Mite just hatched. Only six legs. A Dot in the centre is the real size of the "Mite."

Fig. 4.—Mite swollen by sucking the juices of the Locust, to the wing of which it is attached.

Fig. 5.—Abdominal view of the Mite at this stage—just ready to cast its last skin.

Fig. 6.—Perfect "Mite" with eight legs.

Fig. 7.—The "Digger Wasp" (see pp. 152, 3).

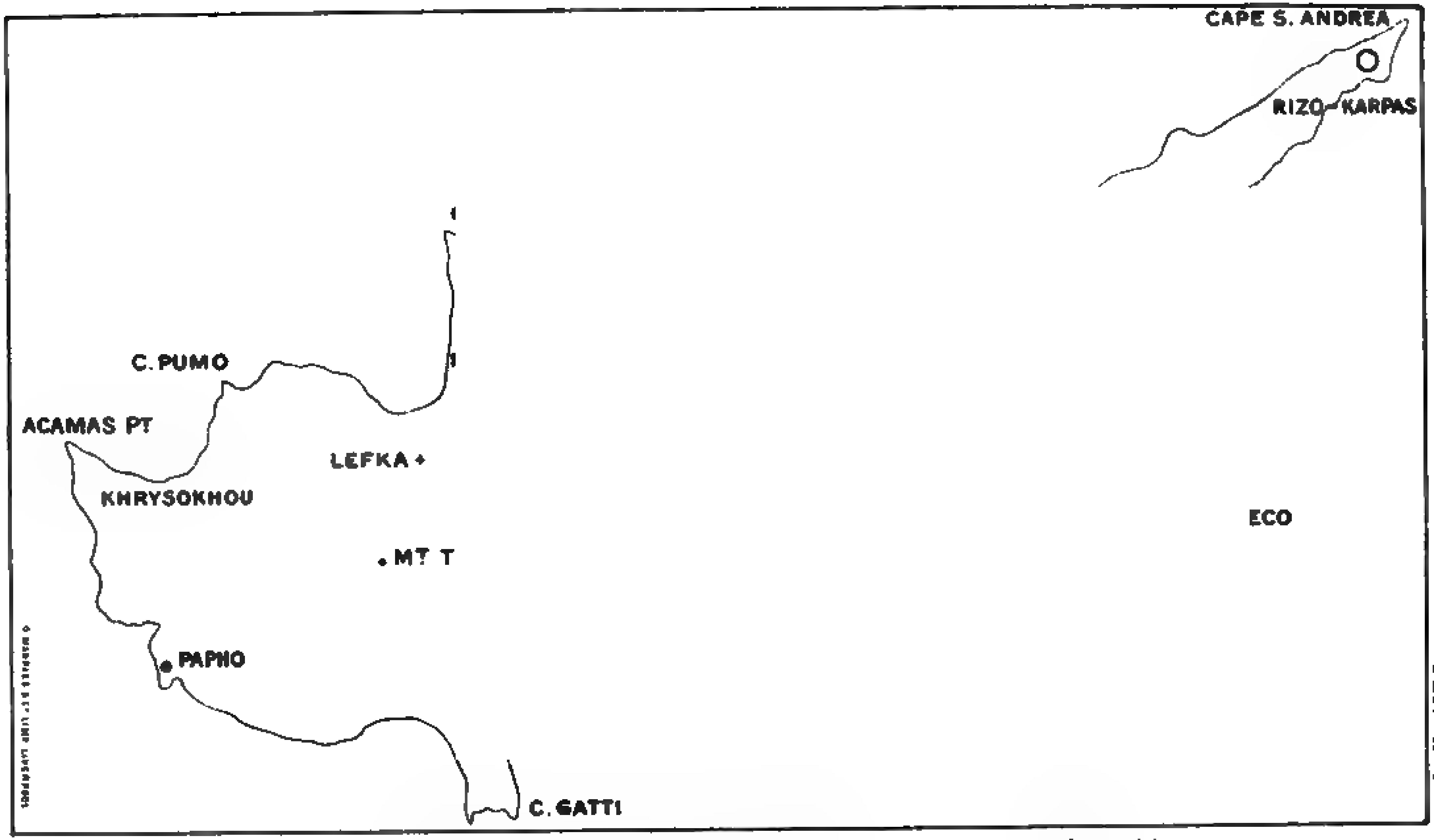
Fig. 8.—Breathing tubes from abdomen of the Cockroach.

Fig. 9.—Chrysalis of Peacock Butterfly.

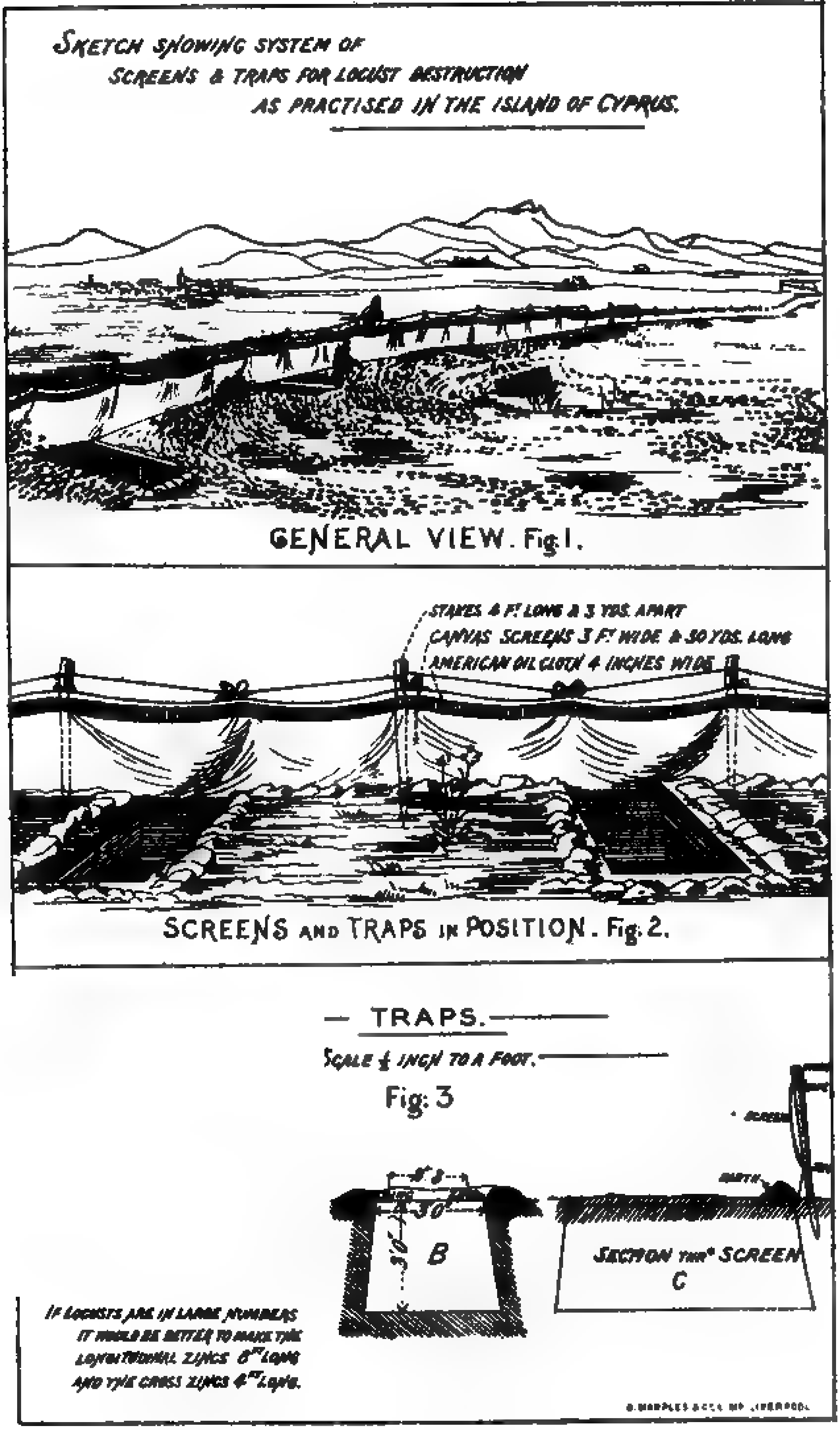
Fig. 10.—The expanded Butterfly (see pp. 136, 7).

Plate V.—Map of North America, to illustrate the portions principally affected by Locusts. The central square embraces the "Rocky Mountain Locust Districts."

PLATE I.

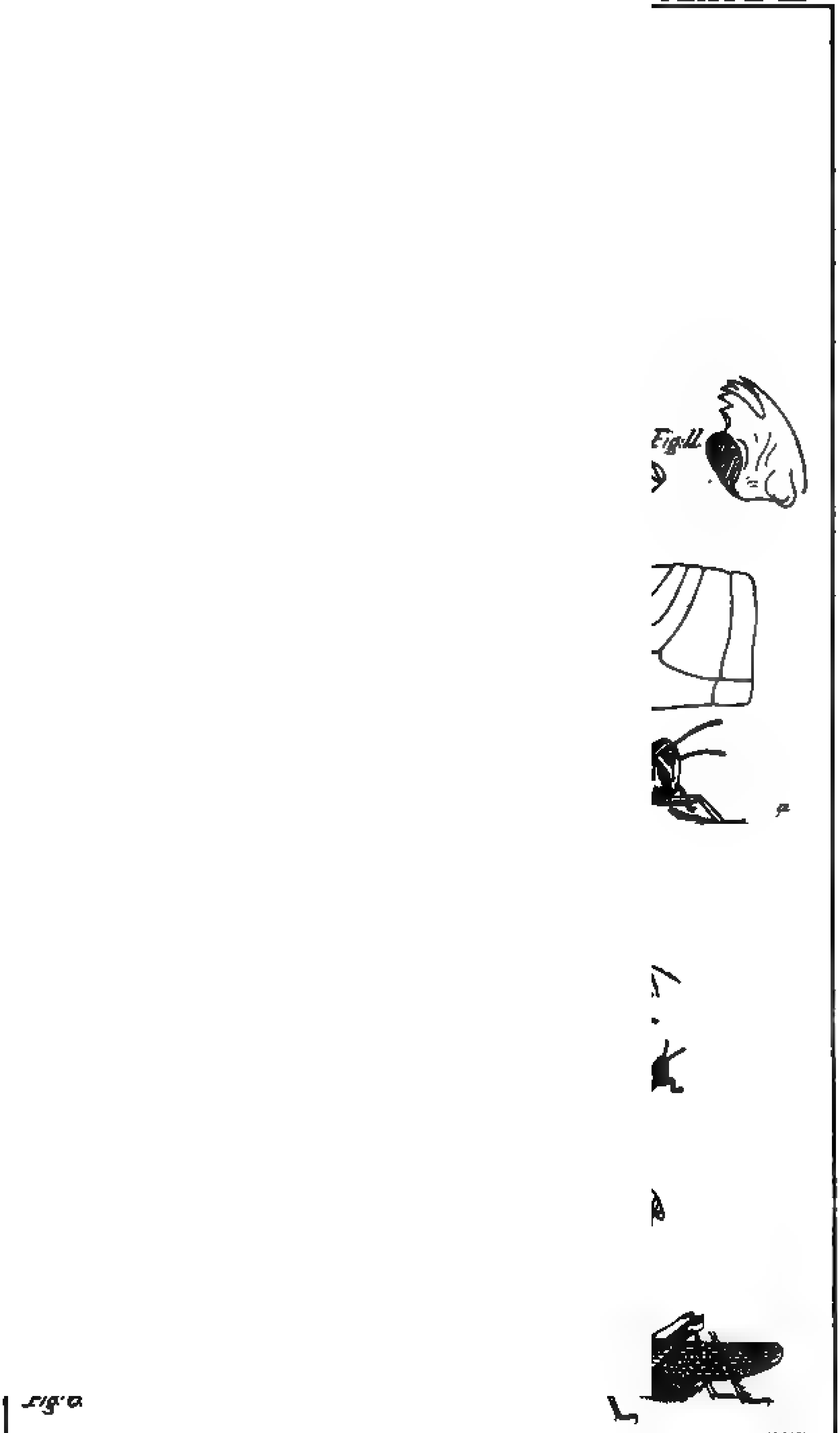



*MAP OF CYPRUS showing the Districts infested with Locusts.* *See Page 128.*




*Copied by permission from S. Brown's Sketches.*

PLATE III.




D. MARPLES & Co. LIMD. LIVERPOOL

*Copied from Entomological Commission (Fig: II Cuvier)*

Fig. 8, 9, 10 Original, remainder copied from Entomological Commission


THE SQUARE COLOURED PORTION IN THE CENTRE REPRESENTS THE "ROCKY MOUNTAIN LOCUST DISTRICT." *See Page 130.*

GREY. *MOUNTAINS AND FORESTS.—Locusts scarce.*
GREEN. *GRASSY PLAINS.—Locust Breeding Grounds.*
YELLOW. *HALF-BARREN SANDY PLAINS AND SAGE BUSHES* { *Locusts scarce* / *Food deficient.* }
YELLOW DOTTED LINE. *The "Temporary Districts" which are Visited by Flying Locust Swarms, but in which they do not Multiply by breeding. See p. 130.*

# JOHN BROWN.

By WALTER LEWIN.

When the name John Brown is mentioned, most Englishmen think of the late lamented lackey of Her Majesty—a respectable person, worthy of esteem in his own place. This is the British John Brown, but in America for nearly thirty years the familiar name has been associated with the man who is described by Mr. Sanborn, his latest biographer, as the "liberator of Kansas and martyr of Virginia." As the subject of a popular war-song his name was once familiar in this country also, though his exploits, like much else relating to the Civil War, may not have been well understood. He was born at Torrington, Connecticut, May 9th, 1800. His ancestor, Peter Brown, like the ancestors of nearly every American of note, was a passenger in that overladen ship the *Mayflower*, in 1620. His father, Owen Brown, by trade a tanner, was, in character, quite as strong a Puritan as the original Pilgrim Father of the family could have been. He is described as "an earnestly devout and religious man, ever respected for his probity and decision of character, an inveterate and painful stammerer," who "could not speak without stammering, *except in prayer*."

In an interesting letter written to a boy friend in 1859, John Brown gave some particulars of his early life. One of the first things he remembered was that when he was four years old he stole three brass pins from a girl, was detected by his mother, and, after being given a day to reflect about his misconduct, was soundly whipped. He was not above telling lies, usually for the purpose of screening himself from blame or punishment, and it

was with difficulty that, in later life, he broke the habit. He was fond of the hardest and roughest play but was not quarrelsome. Of school education he had little, but instead, the rough-and-ready training in self-reliance which was sure to fall to the lot of a child of a pioneer settler. For, when he was only five years old, the family removed to Ohio, then newly opened territory "filled with wild beasts and Indians." He learned all sorts of trades: was a good surveyor, could tan skins, reared sheep and oxen, became a wool-merchant. In his boyhood he had a glimpse of army life, as his father was an army purveyor at the time of the war with England. His senses being keen and his understanding swift, a small opportunity yielded good results. For instance, he learned tanning by merely watching his father at work. In Ohio, coming in friendly contact with the Indians, he obtained some knowledge of their woodcraft. He notes as the one valuable point in his character that "notwithstanding his moderate capacity and still more moderate acquirements," his career was marked by constant success "in accomplishing his objects;" he "habitually expected to succeed in his undertakings."

He was married in 1820 to Dianthe Lusk, daughter of Amos Lusk, a Hudson farmer, a "neat, industrious, and economical" woman, "of excellent character, earnest piety, and good, practical common sense." Her brother, Milton Lusk, quaintly describes her as "a pleasant, cheerful person, but not funny; she never said anything but what she meant." She appears to have been a devout woman; she had "a place in the woods, not far from the house, where she used to go alone to pray." She became the mother of seven children, and died, with the youngest, in 1832. Of the other six children, one died young; four, namely, John Junr., Jason, Owen and Frederick, became efficient helpers in their father's undertakings. Frederick was killed in

Kansas by Rev. Martin White, a rabid Pro-Slavery advocate (1856); Ruth, the daughter, married Henry Thompson.

Brown's second wife, Mary Anne Day, whom he married in 1833, and who died in 1884, bore him thirteen children. Of these, Watson and Oliver were killed at Harper's Ferry (1859); seven died in childhood—four in the year 1843—and four survive. He felt those losses deeply, for he was an affectionate father. Stern even to severity when his children did wrong, he was the tenderest of helpers in times of sickness or other need. His daughter Ruth has given some touching details of his care of her baby-sister Ellen, who died of swift consumption in 1849:—"Father showed much tenderness in the care of the little sufferer. He spared no pains in doing all that medical skill could do for her, together with the tenderest care and nursing. The time that he could be at home was mostly spent in caring for her. He sat up nights to keep an even temperature in the room and to relieve mother from the constant care which she had through the day. He used to walk with the child and sing to her so much that she soon learned his step. . . . I used to be charmed myself with his singing to her. He noticed a change in her one morning, and told us he thought she would not live through the day, and came home several times to see her. A little before noon he came home and looked at her and said, 'she is almost gone.' She heard him speak, opened her eyes, and put up her little wasted hands with such a pleading look for him to take her that he lifted her from the cradle with the pillows she was lying on, and carried her till she died. He was very calm, closed her eyes, folded her hands, and laid her in her cradle. When she was buried father broke down completely, and sobbed like a child. It was very affecting to see him so overcome, when all the time before his great tender heart had tried to comfort our weary, sorrowing mother, and all of us."

The same witness says:—"One thing I always noticed was my father's peculiar tenderness and devotion to his father. In cold weather he always tucked the bed-clothes around grandfather when he went to bed, and would get up in the night to ask him if he slept warm, always seeming so kind and loving to him that his example was beautiful to see." "At one time he sat up every night for two weeks when mother was sick, for fear he would oversleep if he went to bed, and then the fire would go out and she take cold." Once more, this daughter relates how her father, hearing that small-pox had broken out in a town near where she and her husband resided, made a journey of nearly a hundred miles through the wilderness fearing that her husband had not been vaccinated, "and when he told us what brought him," she adds, "I thought was there ever such love and care as his?"

Of the training he gave his children we have some record. His eldest son John, who tells this anecdote himself, had for some time past been sadly negligent and disobedient notwithstanding repeated calls to duty from his father. "He finally grew tired of these frequent slight admonitions for my laziness and other shortcomings, and concluded to adopt with me a sort of book-account something like this:—

"John, *Debtor*

| | | |
|---|---|---|
| For disobeying mother | ... | 8 lashes. |
| ,, unfaithfulness at work | ... | 3 ,, |
| ,, telling a lie | ... ... | 8 ,, |

"This account he showed to me from time to time. On a certain Sunday morning he invited me to accompany him from the house to the tannery, saying that he had concluded it was time for a settlement. We went into the upper or finishing room, and, after a long and tearful talk over my faults, he again showed me my account, which exhibited a fearful footing up of *debits*. I had no credits or offsets and

was of course bankrupt. I then paid about *one-third* of the debt, reckoned in strokes from a nicely prepared blue-beech switch, laid on 'masterly.' Then, to my utter astonishment, father stripped off his shirt, and seating himself on a block, gave me the whip and bade me 'lay it on' to his bare back. I dared not refuse to obey, but at first I did not strike hard. 'Harder,' he said, 'harder, harder!' until he received the balance of the account. Small drops of blood showed on his back where the tip-end of the tingling beech cut through. Thus ended the account and settlement, which was also my first practical illustration of the doctrine of the Atonement. I was then too obtuse to perceive how justice could be satisfied by inflicting the penalty on the back of the innocent instead of the guilty; but at that time I had not read the ponderous volumes of Jonathan Edwards' sermons which father owned."

Alcott's experiments in vicarious atonement it will be remembered were somewhat similar, but he found them instantly effectual, even the more hardened boys, after a brief experience, bursting into tears and begging their teacher to punish them as he would if only they might be spared from punishing him.

As a business man, Brown secured at one time a high reputation as a grader of wool and as a grower of fine Saxony wool. The Agricultural Society of Essex County reported in 1850 that, at their annual show, "a number of very choice and beautiful Devons from the herd of Mr. John Brown, residing in one of our most remote and secluded towns, attracted great attention, and added much to the interest of the fair." He was noted for the honesty of his dealings. One who knew him well, testified, in 1859, "through his life he has been distinguished for his integrity and esteemed a very conscientious man by those who knew him."

When Frederick Douglass visited Brown at Springfield in 1847–48, he found the wool-merchant living, not as he expected, in a fine house, but "in a small wooden building on a back street, in a neighbourhood chiefly occupied by labouring men and mechanics." The furniture was plain, the food of the simplest, and mother, daughters and sons supplied the place of servants. "It is said," adds Douglass, "that a house in some measure reflects the character of its occupants; this one certainly did. In it there were no disguises, no illusions, no make-believes; everything implied stern truth, solid purpose, and rigid economy. . . . . He fulfilled St. Paul's idea of the head of the family. His wife believed in him, and his children observed him with reverence. Whenever he spoke, his words commanded earnest attention. His arguments, which I ventured at some points to oppose, seemed to convince all; his appeals touched all, and his will impressed all. Certainly I never felt myself in the presence of a stronger religious influence than while in this man's house." Brown was living thus frugally in order to save money for his enterprise of freeing the slaves.

Brown's religious views had a strongly Calvinistic colouring, but in after years when he came in contact with faithful heretical men like Theodore Parker, his doctrines, perforce, underwent modification. He believed profoundly in the literal truth of the Bible and in the overruling Providence of God, by whom he felt assured he was called to the work he did. "Brown was a man of conscience, courage, and simplicity," writes Mr. Merriam in his recent biography of Samuel Bowles, "Living amid a complex civilization, he was governed by ideas few and simple as those of an ancient Hebrew. He was a devout Presbyterian, and his library was the Bible." His letters of the earlier period shew a curious blending of piety and business. Almost in a breath he prays for the infinite grace and mercy of God on his son,

and tells of "the nice lot of chickens fattening" for him. As Mr. Sanborn says—"the Kingdom of Heaven and the affairs of earth were closely associated in John Brown's mind as in Cromwell's. He could trust in God and keep his powder dry."

The truth is, Brown's principles and religion were so real to him that he knew no difference between theory and action. To believe a thing was to do it. He transmuted all his ideas into life; manifested himself always and instantly in deeds. No question of expediency or convenience or personal liking ever troubled him; *ought* and *must*, in his vocabulary, were identical. If waiting on the grace and mercy of God and fattening the chickens seemed in his eyes of like importance, it was not because the former did not signify greatly but because the latter did. Whatsoever his hand found to do, he did with all his might. All things fitting to be done were divinely sanctioned. Everything in its place was alike great. His religion was supremely practical.

The distinctive motive force in Brown's character was his love of Justice. A curious illustration of this occurred when he was about fifteen or sixteen years of age. He and a younger brother, named Salmon, were sent for a time to the Morris Academy, Connecticut. Learning one day that some fault which his brother had committed had been condoned by the master, he went to the master and said—"Mr. Vaill, if my brother had done this thing at home, father would have punished him. I know he would expect you to punish him now for doing this, and, if you don't, I shall;" and that night he gave his brother a flogging.

The circumstance which gave this motive force—his love of Justice—its direction, occurred when he was only twelve years of age, and is thus related by himself: "During the war with England, a circumstance occurred that in the end

made him a most determined abolitionist, and led him to declare or swear eternal war with slavery. He was staying for a short time with a very gentlemanly landlord, since a United States Marshall, who held a slave boy near his own age, very active, intelligent, and [of] good feeling, and to whom John was under considerable obligation for numerous little acts of kindness. The master made a great pet of John: brought him to table with his first company and friends; called their attention to every little smart thing he said or did, and to the fact of his being more than a hundred miles from home with a company of cattle alone; while the negro boy (who was fully if not more than his equal) was badly clothed, poorly fed and lodged in cold weather, and beaten before his eyes with iron shovels, or any other thing which came first to hand. This brought John to reflect on the wretched, hopeless condition of fatherless and motherless slave children; for such children have neither fathers nor mothers to protect and provide for them. He sometimes would raise the question: Is God their father?"

In 1837, Brown definitely formed his plans for the liberation of the slaves by force. He regarded this as the task for which he was ordained. From 1838 on, he said, "I never made any business arrangement which would prevent me at any time answering the call of the Lord. I have kept my affairs in such condition that in two weeks I could wind them up and be ready to obey that call, permitting nothing to stand in the way of duty—neither wife, children, nor worldly goods. Whenever the time should come, I was ready."

Next to his unfaltering trust in God, nothing could have sustained Brown in his arduous undertaking better than the absolute confidence and the encouragement he received from the members of his household. Wife, sons, and daughters co-operated with him, giving whatever was needed—home,

comfort, life itself—in the cause. Even his aged father gave money to help it on. "In his own family," writes Mr. Sanborn, "he was always understood." His "earliest, most devoted, most patient and noblest friend" in his enterprize was his wife. In heroism and personal devotedness, his sons and his son-in-law, Thompson, were not second even to him: "not earnest, but earnestness incarnate," as Mr. Redpath described them. There never was a family more united about a public aim. No wonder Thoreau said, "I never hear of a man named Brown now—and I hear of them pretty often—I never hear of any particularly brave and earnest man, but my first thought is of John Brown and what relation he may be to him."

Kansas was to be Brown's first field of action. The territory called Louisiana, ceded by Napoleon to the United States in 1802, embraced the now existing States of Louisiana, Missouri, Nebraska, and Kansas. The first two had been already elevated to the dignity of States when, in 1854, the question of treating Kansas in the same way came before Congress. In the Act passed for Missouri (1820) it was provided "That, in all that territory ceded by France to the United States under the name of Louisiana, which lies north of 36° 30′ north latitude, not included within the limits of the State contemplated by this Act, slavery and involuntary servitude, otherwise than in the punishment of crimes, shall be and is hereby forever forbidden." This enactment is what is known as the "Missouri Compromise." It was accepted by the Slave party on the principle that a bird in the hand is worth two in the bush. The State of Missouri immediately to be founded, was to be theirs, in consideration of the granting of freedom to the prospective States. The hollowness of the bargain was felt acutely at the time by the more staunch friends of emancipation. Thirty-four years later, when Kansas was to become a State,

the concession of 1820, small as it appeared at the time, was more than the victorious Slave party cared to allow. Accordingly, after various proposals, the "Kansas-Nebraska Bill" was passed. This nullified the old agreement that, in the territory which included Kansas, slave labour should be "forever forbidden." In place of it, "squatter-sovereignty" was legalised; that is to say, the settlers were to decide for themselves for or against slavery. The Slave party posed for the moment as the upholders of popular rights. Yet the real holders of Kansas at that time were some twenty tribes of Indians and six or seven hundred white men and women, and the Act expressly provided for the ejection of the twenty tribes of Indians. The people to whom sovereign rights were secured had yet to be provided, and it was expected, not unreasonably, that the neighbouring slave States, and especially Missouri, would supply the majority of these. The passage of the Kansas-Nebraska Act had, however, the unexpected effect of arousing the North to unwonted activity. Migration to Kansas was stimulated from the North as well as from the South. A Massachusetts Emigrant Aid Company (afterwards the New England Emigrant Aid Company) was organised at Boston. Many persons were induced to remove and settle in Kansas, and thereby secure to themselves a right to a voice in the decision. It was a quiet struggle for possession, in order to determine whether the new State should be Free-soil or Slave-soil. The Free-soil advocates, be it remembered, were not identical with the Abolitionists. At first, and for some time, they were careful to disclaim all sympathy with Abolitionists. At one of their earliest Conventions, under the presidency of J. H. Lane, a demagogue, they passed a resolution that "the best interests of Kansas require a population of white men," to the exclusion of all negroes, whether bond or free. Even as late as 1858, slave-labour from Missouri was hired by Free-

soil men resident in Kansas. The Free-soil advocates merely objected to the increase of slave territority; they were quite willing that the institution should continue unmolested wherever it had got foothold. It was the attitude of the greater portion of the North up to the time of the Civil War. That war was not commenced against slavery; it was a war for the maintenance of the Union—nothing more. It was only because the Abolitionists saw and used their opportunity that the character of the struggle changed.

On October 7th, 1854, Andrew H. Reeder was appointed first Governor of Kansas, and, the territory having been divided into districts, an election took place of a delegate to Congress, a Pro-Slavery man being chosen. The far more important election of the Territorial Legislature followed on March 30th, 1855. The census taken in February showed the population to be 8,601, of whom 2,905 were legal voters. At the election in March 6,307 votes were polled. This striking result was brought about by the simple expedient of importing roughs from Missouri for the occasion. Thousands of these poured over the border, and when asked to show their credentials as voters, usually quelled any doubts by producing their pistols. The Legislature thus chosen assembled at Pawnee, July 2nd. Its first act was to eject nine Free-soil men who had been elected, after which the two others resigned, leaving the Slave-party in full possession. The further proceedings of this Assembly consisted in the passing of a Slave-code, which provided among other things that the punishment for kidnapping a free negro and returning him to slavery should not exceed imprisonment for two years, but that any one aiding a negro to escape should suffer death. Here are some other clauses:—

"Sec. 12.—If any free person, by speaking or by writing, assert or maintain that persons have not the right to hold

slaves in this Territory, or shall introduce into this Territory, print, publish, write, circulate, or cause to be printed, published, written, circulated, or introduced into this Territory, any book, paper, magazine, pamphlet, or circular, containing any denial of the right of persons to hold slaves in this Territory, such person shall be deemed guilty of felony, and punished by imprisonment at hard labour, for a term not less than two years.

Sec. 13.—No person who is conscientiously opposed to holding slaves in this Territory shall sit as a juror on the trial of any prosecution for any violation of any of the sections of this act."

The Free-soil party having repudiated this Legislature, proceeded to elect one for themselves. Their "Legislature," known as the Topeka Convention, met on October 23rd—Lane being president—proceeded to make a "constitution" which prohibited slavery in the State after July 4th, 1857, and conferred the suffrage on white male citizens and civilized Indians. They got this constitution ratified at the polls by 1,731 votes for to 46 against, and an unsuccessful attempt was made to induce Congress to authorize it.

It was not to be expected that the opposing factions would be content with meeting in rival conventions and passing laws which could not be enforced. The struggle soon assumed a more serious and practical aspect. On January 5th, 1856, an election of officers took place under Free-state auspices, Dr. Charles Robinson being chosen Governor. On this occasion a skirmish occurred at Easton, in which a pro-slavery man was killed; Captain R. P. Brown (not related to our hero), who had led the Free-soilers, fell, next day, into the hands of his enemies, and they murdered him under circumstances of unspeakable horror. His offences were that he had defended the ballot boxes, had

himself voted, and had helped to rescue a neighbour from ruffians. No one was arrested.

Other outrages had occurred already. On October 25th, 1855, Samuel Collins was attacked by one Laughlin and three or four others, and shot dead. On November 21st, Charles Dow, described as "a quiet, peaceable young man," was murdered in open daylight by Franklin Coleman. "The body was left lying by the side of the road where he fell until sundown," when word was sent to Branson, at whose house he boarded, by one of the accessories, "that a dead body was lying by the roadside." Branson himself, who was guilty of no other offence than that he was a possible witness against Coleman, was arrested the next day by Sheriff Jones. Some of his friends, however, rescued him the same night. All the official authority was in the hands of pro-slavery men of a rough and brutal type, so no remedy could be hoped for in that quarter. The Government at Washington, too, was so much in subjection to the slave-power that it would have been equally hopeless to look to it. Not long after (1857), in the Dred Scott case, the Supreme Court declared that "no person who was of slave descent, or African blood, could ever be a citizen of the United States or have a right to sue in the courts;" and further, that "the prohibition of slavery north of 36° 30′ was unconstitutional and void, Congress having no power to exclude slavery from the National Territories." Clearly the Free-State men must look elsewhere for help, and, accordingly, under the guidance of Dr. Robinson, a clear-headed fearless Abolitionist, they sent to Massachusetts for a supply of Sharpe's rifles.

So matters continued. On May 22nd the town of Lawrence was attacked by official authority, because it was a Free-State town and the Emigrant Aid Company had built a hotel there. The hotel was destroyed, the inhabitants were robbed and some of them carried off as prisoners.

At that very time, in the Senate House at Washington, Charles Sumner was stricken down and nearly killed by a fellow-member because he had made an anti-slavery speech. "The palsy of death," wrote the aged Josiah Quincy, five days after, "The palsy of death rests on the spirit of freedom in the so-called Free-States."

Meanwhile John Brown, in his mountain home, and about his business, rearing sheep, selling wool, tanning leather, was turning over in his mind his conviction that slavery was wrong and that it must be overturned by force, and was awaiting the "call of the Lord" to go and overturn it. Five of his sons were among the first settlers in Kansas. They went out from Ohio, with eleven head of cattle, three horses, and some choice plants, and with little besides, and their intention—like that of most other settlers from the North—was to earn a livelihood by farming, whilst by their presence they would also be aiding the cause of freedom. But, when they found that they would be required not only to farm their land but to defend their lives and property from lawless invaders, they wrote to their father to send them arms and ammunition.

In this summons he heard the expected "call," and accordingly, instead of sending the arms and ammunition, he went to Kansas with them himself, taking also another of his sons and his son-in-law, Henry Thompson. They arrived October 6th, 1855. The previous autumn, when his sons had invited him to accompany them, he had declined, saying his field of action lay elsewhere, but subsequent events changed his plan. Though resolute to allow nothing to stand in the way of his duty, it must have been a sore trial to him to leave his home. "I think much of your widowed state," he wrote to his wife soon after he reached Kansas, "and I sometimes allow myself to dream a little of again, sometime, enjoying the comforts of home; but I do not dare

to dream much. May God abundantly reward all your sacrifices in the cause of humanity and a thousand-fold more than compensate your lack of worldly connexions."

Quite unlike those "comforts of home," of which sometimes he allowed himself "to dream a little," were the realities which faced him. A log-cabin, neither rain-proof nor wind-proof, scanty food, scantier clothing, some of the family stricken with ague, amid blighting frost—the rain forming into icicles as it fell—and with enemies all around, the outlook that October was not cheering. Yet "after all," wrote Brown to his wife, "God's tender mercies are not taken from us. We get, day by day, our daily bread, and I wish we had all a great deal more gratitude to mingle with our undeserved blessings."

Brown's method differed from those adopted by the other settlers of the Free-State party. He had little faith in assemblies and conventions. If a thing had to be done he thought it better to do it himself than to present a petition to some one else to get it done. Accordingly he and his followers went into camp, and there awaited and seized their opportunities. When the outrages on citizens had reached their height, while the Free-soil advocates, deprived of their leader, Robinson, who had been arrested, were practically in a state of collapse, Brown came forward, and in a terrible but effectual manner reasserted the down-trodden rights. Two days after the destruction of Lawrence, the so-called Pottawatomie executions took place.

The event was in this wise: the number of Free-State men at that time actually killed in cold blood was five and no punishment had been awarded to their murderers. To submit quietly meant that the cause of slavery against which Brown was struggling would triumph there. Moreover, it was reported that a further attack was imminent. The cabin of the Browns was to be set on fire and the inmates shot as

they tried to escape. This was hearsay, and John Brown wanted proof whether these men who were said to have planned the attack really had "committed murder in their hearts." He disguised himself as a surveyor, took his lines, went to the encampment of some of Colonel Buford's company, and got into conversation with the men one by one. The story was quite true. "I hear that there are some bad men about here by the name of Brown?" he said to one. "Yes, there are," was the answer, "but next Wednesday night we will kill them." On Friday, May 23rd, Brown and seven picked men (Frederick, Owen, Watson and Oliver Brown, Henry Thompson, Theodore Weiner and James Townsley) left Brown's camp and were absent for two days. On Sunday morning it became known that five ruffians had been stricken dead. Their names were James P. Doyle, his sons William and Drury, Allan Wilkinson and William Sherman. "The blow," writes Mr. Sanborn, "followed as a signal to every Kansas ruffian that blood must recompense blood. For every cold-blooded murder heretofore perpetrated—for Dow, Barber, Brown, Stewart and Jones—the sabres of Pottawatomie requited life for life." Other opinions were of course expressed. Persons who had regarded the murder of Free-State men with much complacency were made furious by this retaliatory act of Brown. Andrew Johnson in the Senate blustered about "innocent unoffending men," who were "taken out and in the midnight hour, and in the forest, and on the road-side, fell victims to the insatiable thirst of John Brown for blood." The act was the turning point in the fortunes of the Free-State cause.

We need not follow the footsteps of Brown through Kansas. He remained there long enough to prove how great is the power of a few brave men if they have a righteous cause behind them. "Give me men of good principles," Brown said, "God-fearing men, who respect themselves,

and with a dozen of them I will oppose any hundred of such men as these Buford ruffians." When I speak of a righteous cause I mean one in which a man's principles are involved, in which he believes with his heart and soul, and if need be with sword and gun. It is not the 'ism' with which it is labelled that gives the cause its character. 'Stonewall' Jackson's cause was righteous, although its external purpose was precisely the opposite to that of John Brown. But the 'cause' of the ruffians who invaded Kansas had no righteousness in it. These men were neither brave nor honest. They came to plunder and to kill for their private ends. At this distance of time it is ludicrous to read how easily Brown and his men put bands ten times their number to ignominious flight or made them prisoners. The name of Brown became a terror to his enemies. The most exaggerated stories were told of his deeds of prowess. His followers, who numbered themselves by tens, were numbered by their enemies by hundreds. Every victory gained was attributed to him as well as many a deed that never was performed at all. At this day, Mr. Sanborn tells us, "this Ohio Puritan is the best known name in Kansas; not that the million people, white, black, and red, who now dwell in this State all know accurately who he was and what he did; but they have all heard of him and keep his memory alive by tales and disputes. And in the districts where he moved about, armed at all points, the air is full of legends concerning him—some true, some false, and most of them neither true nor false, but a mixture of both."

In 1858, after leaving Kansas for several months, Brown returned for a brief visit. He had an interview with Dr. Robinson. "You have succeeded," he said, "in what you undertook. You aimed to make of Kansas a free State, . . . . but I had another object in view. I meant to strike a blow at slavery." In December he made a raid into

Missouri and liberated eleven slaves. Stewart, the Governor, offered $3,000 for his head; but his task there was finished, so he carried his negroes to safety in the north and did not return.

In 1859 Brown went to Harper's Ferry. He, with several friends, took a house in the neighbourhood some time before the meditated attack, in order to make arrangements. They got together all the necessary guns, ammunition and other stores, and by the middle of October were ready. The whole scheme had long before matured in Brown's mind. He explained it to Douglass in 1847, thus:—"These mountains (in Virginia) are the basis of my plan. God has given the strength of the hills to freedom; they were placed here for the emancipation of the negro race; they are full of natural forts, where one man for defence will be equal to a hundred for attack; they are full also of good hiding places where large numbers of brave men could be concealed and baffle and elude pursuit for a long time. I know these mountains well. . . . The true object to be sought is, first of all to destroy the money value of slave property; and that can only be done by rendering the property insecure. My plan, then, is to take at first about twenty-five picked men, and begin on a small scale. . . . The most persuasive and judicious of them shall then go down to the fields from time to time, as opportunity offers, and induce the slaves to join them, seeking and selecting the most restless and daring." As a preliminary, the arsenal at Harper's Ferry was to be seized. This was done on October 19th, 1859, with nineteen men. They held the place for thirty hours, when a company of United States marines arrived and overpowered them. A suspicion of treachery seems to have hastened Brown's action and all the help he expected had not arrived. Even then the escape to the mountains might have been effected had he not delayed

at the arsenal. "I should have gone," he admitted after, "but I had thirty odd prisoners whose wives and children were in tears for their safety and I felt for them. Besides, I wanted to allay the fears of those who believed we came here to burn and kill. For this reason I allowed the train to pass the bridge, and gave them full liberty to pass on." This train carried the tidings of the outbreak and hastened the arrival of the troops. Had Brown carried out his scheme, there is no reason to think he would not, to a great extent, have effected his object. As it was, eight of his men—two of them his sons—were killed; five escaped, and five others as well as Brown, who was badly wounded, were captured. Of the incredible brutality of the Virginians on the occasion—the cruelty to the living, the insults to the corpses of the dead, I need not speak, nor is it necessary to recall the details of Brown's imprisonment, of his trial and its foregone conclusion, and his execution at Charlestown, in Virginia, December 2nd, 1859. The dilemma of the Virginians was a serious one; they did not dare to save him alive, yet scarcely dared to hang him. For their own interests, perhaps, it did not matter which they did. The system they sought to uphold had rotted at last; with the next shock it would fall. The death of John Brown produced that shock.

Judicious persons—including even Garrison—thought Brown had blundered—his action was not "timely." Some declared he was insane; one Southern paper called him a "miserable old traitor and murderer," but the best men, Emerson, Thoreau, Wendell Phillips, Theodore Parker, and a few others, saw at once that Brown was right and his accusers were wrong. Many came to see it afterwards.

John Brown died, as he had lived, with a just man's fortitude, displaying when he had to suffer the same unconscious heroism that he displayed whenever he had to act.

Lady Trevelyan's words about her brother, Lord Macaulay, may fairly be applied to Brown: "Such was his high and simple nature that it may well be doubted whether it ever crossed his mind that to live wholly for others was a sacrifice at all." Whatever fell to the lot of Brown to do, whether a humble work or a magnificent one—tending sheep on the mountains or making war against the United States with nineteen men—he did with equal simplicity and thoroughness. One was as important as the other in its own season. All that troubled him was the sense of his own unworthiness. He was a born Lover; not a destroyer, but a builder up; an enemy to the institution of slavery incidentally; actually a friend of Justice. Love of Justice was his motive force. This and his unconscious heroism mirror themselves in every incident recorded of him. When he was a tanner he would not sell leather by weight unless the last drop of moisture had been expressed from it. In the same spirit he organized the terrible midnight execution of five men in Kansas. He had no hatred against these men, scoundrels plotting his own death though they were. He was never guilty of indifference, much less of wanton cruelty toward friend or foe. Mr. Daingerfield, who was one of his prisoners at Harper's Ferry, has lately borne witness to this. In the *Century* for June, 1886, he writes:—

"Often, during the affair in the engine-house, when his men would want to fire on someone who might be seen passing, Brown would stop them, saying, 'Don't shoot, that man is unarmed.' He had made me a prisoner, but had spared my life and that of other gentlemen in his power; and when his sons were shot down beside him, almost any other man, similarly situated, would at least have exacted life for life."

Justice was paramount, and petty compassion for casual victims was not allowed to come in its way. Once

only Brown was weak in this respect, and the blunder wrecked his plans and cost him his life. He was not eager to make men comfortable any more than he was eager to be comfortable himself; yet he was ever sensitive to others' needs. At home he was stern towards his children's faults, but in sickness he was the best of nurses, counting nothing troublesome if it was helpful. All his ideas rushed straightway into action. While Garrison and other Abolitionists were denouncing and arguing and trying to show persons and governments their duty, he, without any talk, had set to work, and, instead of proclaiming the abolition of slavery, was abolishing it. As soon as he saw that a thing was to be done he began to do it himself. The glory of John Brown and his companions is not that they were instrumental in liberating a race, or that they were on this side or that in public movements, but that they were single-minded. Nothing they were called to do was too lowly to be done faithfully or formidable enough to daunt them. Such men do not merely save from physical bondage, they are redeemers of the world.

# REPORT ON A SUCCESSFUL ATTEMPT TO INTRODUCE LIVING SOLES TO AMERICA.

By THOMAS J. MOORE,

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THE geographical distribution of animals has important bearings on the welfare, comfort and luxuries of mankind. The camel of Arabia, the reindeer of Lapland, and the fur-bearing animals of the Far West are examples among mammalia.

The naturalizing of the fowl, turkey and pheasant, are examples among birds of the extent to which man can influence their distribution for his own benefit.

And the progress of the modern science of fish culture promises well for the naturalization of important and delectable food fishes in parts of the world where they did not previously exist.

The success which, after repeated failures, crowned the efforts of the persevering men who have introduced salmon and trout to Australia and New Zealand, is a case in point; and the successful breeding of the American Brook Trout, *Salmo* or *Salvelinus fontinalis*, in Britain is another.

Now the American lakes, rivers and coasts, though abundantly supplied by nature with food fishes both of nutritious and dainty kinds, are not provided with certain sea fishes with which we are specially favoured in the British Islands, and which are in the highest esteem for the table. The American States on the Atlantic side, have neither soles nor turbots: and as a consequence the Americans are not happy!

In the Gulf of Mexico and East Florida they have a

couple of Flounders, and they have there also another flat fish (*Hemirhombus pætulus*, Bean), but of this last, all the specimens but one were taken from the stomachs of Red Snapper Fish (*Lutjanus blackfordii*). The limited supply of this flat fish being so largely appropriated by appreciative Snappers, there remain only the Flounders, and what are they that should serve as substitutes for Soles or Turbots?

The absence of the sole and the turbot has of late impressed itself on the American mind, and some ten years ago, Professor Spencer F. Baird, the Director of the United States Commission of Fisheries, took the matter seriously to heart.

The successes which had attended the manual propagation of the salmon and other important food fishes in Europe and America, led him to consider the possibility of this method to supply the deficiency. With this object in view, he wrote to me asking if facilities would be given for the purpose, by the owners of Liverpool fishing smacks, if he sent a couple of agents from America to manipulate the spawn of soles and turbots as soon as taken from the trawl. The late Mr. Isaac, of St. John's Market, at once promised every facility for the purpose, as far as boats and trawls were concerned, but pointed out difficulties as to times and seasons which then, at least, were unfavourable.

Subsequently, Professor Baird changed his views as to this method of proceeding, and determined to experiment on the transportation of the fish alive.

To this end, after enquiries made, he put himself in communication with Mr. W. C. L. Jackson, then chairman of the Southport Aquarium Company, who, with Mr. Long, the manager, entered heartily into the proposal, for the mutual benefit of both parties by exchanges.

Accordingly, soles and turbot of moderate size were

obtained from the local fishermen, and placed in the store tanks of the Southport Company, where they remained in readiness for shipment. One of Professor Baird's practical fish culturists, after delivering large numbers of impregnated ova of *Salmonidæ* in London and on the Continent, arrived at Southport, and, after most careful preparations for transport, shipped a moderate supply of fish.

Great attention was paid during the transit as to temperature and aëration, but only two soles, out of thirty shipped, survived to be put out in Massachusetts Bay,* or less than seven per cent. The losses were believed to be due to the fall of temperature when off the banks of Newfoundland. This was in January, 1878, and was very disheartening. A second attempt, in 1879, was a complete failure, as the fish were taken by rail from Southport to Southampton for shipment, and were bruised and fatally injured by the roughness of this overland journey.†

Another attempt was made from Southport in 1881, with poor results. Seventy soles were shipped on board the *Parthia*, and only three arrived out alive, or less than four per cent.

In April, 1880, Capt. John H. Mortimer, premier Associate of this society, had come in with his little pop-gun, if I may be excused for so calling his simple ship-aquarium, which I, at its first introduction, some twenty odd years ago, named after himself.

In three or four of these Mortimer Ship-Aquaria, he succeeded in safely landing five young soles out of nine that were shipped, or a proportion of over fifty per cent. These were provided by and sent from this Museum, and were deposited by Mr. Eugene Blackford just outside Sandy Hook.

* *Forest and Stream*, Nov. 3, 1881, p. 274.

† *Forest and Stream*, Nov. 3, 1881, p. 274.

This amount of success pointed to *one* promising method, at least, of solving the problem how to get soles alive across the Atlantic; and the trial in this case was the more severe inasmuch as it took place in a slow-sailing cargo ship, and not in a steamer. It had the great advantage, however, of Capt. Mortimer's unremitting attention.

During the present autumn, 1885, Mr. W. A. Duncan, of the firm of Duncan & Sons, fish merchants of St. John's Market, Liverpool, being about to spend a few weeks in the States, informed me that he contemplated taking some live soles with him. They were to be carefully collected by his own trawlers, and he was anxious respecting the best method of transport, about which he was desirous of consulting me. On due consideration he ordered a supply of fish globes, and slung them up on Capt. Mortimer's plan. Circumstances, however, prevented him carrying out his intention, and he had reluctantly to give it up.

By permission of the Liverpool Library and Museum Committee, I had placed half-a-dozen small soles, from the Museum Aquaria (where they had become "seasoned" and accustomed to confinement), together with one of Mr. Duncan's own specimens, in Mortimer Aquaria, with a desire to take advantage of Mr. Duncan's kind offices in bringing something in return for them on his voyage home.

Our good friend, Mr. Eugene Blackford, of Fulton Market, New York, who is one of the leading members of the U. S. Fish Commission, would, I was sure, as on former occasions, reciprocate; and being desirous of adding to our American specimens by way of exchange, I applied to Mr. W. S. Graves, who, on behalf of the White Star line, kindly gave permission for half-a-dozen globes to be shipped immediately before sailing, on the 8th of October, by the R. M. S. S. *Britannic*, under the command of Captain Hamilton Perry. The six globes, with two soles in each, were delivered on board

by Mr. R. Paden, Museum Assistant, and by Capt. Perry's direction were suspended in the saloon, and open, of course, to constant observation. My only fear, on hearing of their being so honourably placed, was lest the temperature might be too high. Great, however, was my satisfaction on going on board, immediately on the return of the *Britannic* to Liverpool, to hear that of the supposed dozen specimens three had died, and eleven had been delivered alive and in good condition. This report, though so eminently satisfactory, was, to say the least, somewhat puzzling. The discrepancy in numbers was, however, due to a couple of fish having so effectually buried themselves in the bed of sand, with which each aquarium is supplied, as to be unobserved when the census was taken before leaving the Museum. This result is equal to more than seventy-five per cent. delivered alive.

A report in *The American Angler*, published in New York on the 24th of October, states that "these soles are to be sent to the Cold Springs Hatchery, on Long Island, and afforded facilities for breeding which it is hoped *they may sensibly avail themselves of.* The sole is, without question, the most delicious of the flat fishes for the table, and its addition to the food fishes of our waters would be a very valuable acquisition." Cold Springs Harbour is a station of the U. S. Fish Commission, for hatching eggs of various *Salmonidæ*, for distribution in New York and vicinity (*Fish Industries*, p. 69).

Mr. Blackford writes as follows, under date of Oct. 31, 1885 :—

"I received by the steamer *Britannic* the lot of sole which you have so kindly sent to this country, and I must congratulate you upon the success which attended their safe transportation. . . . I shall take great pleasure in sending you, at the first opportunity, some of the living Amphibians, etc., which you desire."

The aquaria, or fish globes, used in the transport of these fish, are of thick glass, and weighty. They are fourteen

inches in diameter at the middle, seven inches across the mouth, and hold about four gallons of water. They simply rest each on a circular wooden disc, an inch thick and sixteen inches in diameter, suspended by light cords to a stout ring, by which they may be hung on a hook, like a swinging lamp.

A layer, an inch or two in depth, of fine sea-sand from the Cheshire shore, covers the bottom of each globe, which is rather more than half filled with sea-water.

The whole affair is simplicity itself, and would be almost absurd for the accomplishment of any serious purpose, if it were not for its proved success.

That it is not to be despised, however, is evidenced by the following summary of what has been accomplished with it in the service of the Aquarium of the Liverpool Museum, as given on the placard attached to the pair of globes now

exhibited, each globe containing a couple of soles* as in the experiments above recorded:—

"By the simple contrivance of suspending ordinary fish globes (the most convenient vessels for the purpose), after the manner of cabin lamps, small aquaria of considerable utility can be kept at sea as easily and safely as on shore. They thus supply a very convenient means for the observation and study of the various living objects of small size obtainable by the dredge, or by the towing-net, and also afford a pleasant and useful resource to break the dull monotony of life at sea.

"Originally designed by Capt. Mortimer to facilitate his own studies, and for the conveyance of living American fish to the Liverpool Free Public Museum, they have been the means, by himself and others, of importing to the aquaria of that institution a considerable number and variety of living fish and other objects, not only from New York, Boston, and other parts of North America, but also from Brazil, from Chili, from the Mediterranean, from the West Coast of Africa, and from the Indian Ocean; and although the capacity of such simple vessels is necessarily small, it has sufficed for the successful importation of several young sturgeons from Hamburg to Liverpool."

The special advantages of the Mortimer Ship Aquarium, for purposes like the present are as follows:—

Its extreme simplicity, and the small amount of trouble involved.

Its "handiness" in conveyance to and from the ship, as well as on board.

Its transparency, giving every facility for observation, whether for study or mere inspection as to purity of water and health of fish.

Its easy swinging motion when suspended, the surface of the water being but little disturbed during considerable departure from the vertical centre.

* These soles so effectually buried themselves in the sand at the bottom of the globes, that it was necessary to stir them up with the hand to prove they were really there; indeed I had to do the same thing before bringing the globes to the meeting, to satisfy myself. This is conclusive proof of the kindly way in which they take to the sandy bottom provided for them.

Its facilities for feeding the fish if required, and for the removal of refuse; as also for drawing off the water when requisite, and supplying clean water in its place.

Its facilities for simple aëration.

Its saving, more than any other form of vessel, of the fish from injuring themselves by striking against the prison walls, by the motion of the ship, or otherwise, a matter of the greatest importance.

Its comparative strength, similar aquaria having been carried four times across the Atlantic in all weathers, and in the long voyages of a sailing ship, without coming to grief.

It facilitates also the use of sand as a bed or bottom.* The soles, by the waving motion of their body and fins, cause the sand to rise, and, in falling, to cover them so effectually that they are scarcely discernible, as evidenced above. Sometimes only their eyes, or an outline of the head or body, can be seen; at others a circular track only is visible, caused by the continued moving of the fish, which perforce results in a circular outline of its track.

The comfortable look of the soles, often to be seen in our large aquaria, was so striking in those put into the globes for Mr. Duncan, that it made me more than ever bent upon so accommodating them. They had all the appearance of being literally tucked up in their bed, and lightly breathing!

These advantages are difficult or impossible of attainment, singly or in combination, in vessels of wood or iron. Much ingenuity has been exercised as to the construction and aëration of tanks of various kinds and sizes, and the

* I attach great value to this use of sand, and always use it or an equivalent in all aquaria. The late Mr. W. Alfred Lloyd objected to it as likely to choke any fish, but I have never found it to do so; on the contrary, the gills keep themselves clear from its intrusion by their own action.

regulation of temperature, for transporting soles on a far larger scale, but the results hitherto have not been commensurate with the labour expended, and the importation of soles to America in greater numbers than above recorded has yet to be accomplished.

There is, however, an all-important matter requiring attention, besides the form of vessel in which the soles are to travel, and that is, as in so many other matters, you must first catch your fish, which itself is comparatively easy; but this is not enough—you must catch him without injuring him, which is by no means so easy, at any rate with a trawl, and impossible in a trawl working in the ordinary way for fish for market. Trawls so working are down for several, perhaps five or six, hours. And how can fish, especially small ones, escape without bruises of every degree of violence. And how can bruised fish be expected to live? Now the soles in the Museum Aquaria are of small size, from four or five inches in length upwards. These are caught and brought in by poor boatmen, fishing with small nets only, in or at the mouth of the Mersey, and consequently the fish are less injured. The specimens sent to America were thus caught, and had time to die or to get well and used to confinement—seasoned, in fact, or educated, as Mr. Duncan has called it—before being "transported." These circumstances have doubtless had a share in the success of the venture, the main cause of which was due to carefully changing the water daily, by Mr. Bartholomew, the chief steward, and his assistants, in whose kindly care all these consignments have been placed. The three deaths mentioned occurred before the water was so changed, and none occurred after in that consignment.

Up to the time of writing this communication, I have not heard the result of the last experiment on a large scale. Some five hundred soles, specially and most carefully

trawled for off the south coast of England, were shipped by the *Gallia* on the 24th of October. Every care and precaution was taken for their safety, and a trained attendant (an able seaman) accompanied them to Liverpool, and sailed with them to America.

The cost of these experiments, on a large scale, is great. If successful in the percentage delivered alive, that, of course, will be the broad road of future supply. If otherwise, the Mortimer road, narrow though it be, may admit of a stream tending towards the accomplishment, by inexpensive means, of this very laudable object.

The method thereof is due to the ingenuity of a native-born American, and I have much pleasure in recording its latest success before the Society who first appreciated his devotion to natural history pursuits, and elected him their first Associate Member.

"Gratitude is a lively appreciation of favours to come;" Mr. Blackford has already sent in return living specimens of the Limulus or King Crab, and promises fish and amphibia to follow. King Crabs are not new to us, but we have long been without them.

Our first living specimens were brought by Captain, now Sir James Anderson, while in the Cunard service, prior to laying the Atlantic Cable from the *Great Eastern* steam ship. That supply, I think the first imported to England, beside supplying our own wants to the full extent of our accommodation, enabled us to send living examples to London, Oxford, Dublin, and elsewhere.

Dr. David Walker, late naturalist to the *Fox* expedition in search of Sir John Franklin's remains, going on a visit to Paris, kindly took one wherewith to initiate friendly relations with naturalists there. But the Professor he took it to was at dinner, and would not be seen; and was so long at dinner, that Dr. Walker took umbrage, brought his King Crab back

again across the Channel, till just before landing, his patience and endurance being quite exhausted, he threw the exceedingly awkward prickly creature overboard. Some short time thereafter, Dr. J. E. Gray, of the British Museum, received a specimen which had been washed ashore on the south coast, and, therefore, positively asserted it to be an important addition to the Marine Fauna of England!

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NOTE.—Since the above communication was read, several further consignments have been as successfully made by the same means and by the same channel. It has been found that four specimens may be safely transmitted in each globe, and on one occasion, I was informed by Mr. Bartholomew, that every one of the twenty-four shipped in the six globes arrived alive at New York, giving the coveted rate of cent. per cent. on a shipment, and showing that complete success is possible of attainment, though of course some losses will generally occur. Mr. Blackford, previously to this, had written as follows:—

"January 18th, 1886.

"I am in receipt of your esteemed favour of the 31st ult., and am also in receipt, per steamer *Britannic*, of the live Soles. I cannot express my joy and gratitude in view of the interest your Institution has taken in this exchange. I see in it the promise of the successful carrying out of what I have long desired, that is, the importation of a sufficient number of these fish that shall enable us to determine whether they can be acclimated and breed in our waters."

Of one of the late consignments, Professor Spencer F. Baird, Chief of the U.S. Fish Commission, writes thus to me:—

"Woods Holl, Mass., July 16th, 1886.

"I am happy to report the success of the latest shipment of Soles made to Mr. Blackford, per *Britannic*, for the service of the U.S. Fish Commission. Twenty of the twenty-five shipped are alive and in good condition, *and feeding voraciously in our tanks*."

Of a still later consignment of twenty-four fish, of which six died, possibly from the excessive closeness and warmth of the weather, before the *Britannic* reached Queenstown, Mr. Blackford writes thus:—

"New York, Aug. 26th, 1886.

"I received through the hands of Mr. Bartholomew *seventeen* live English Soles, which I at once forwarded to the U.S. Fish Commission's Head Quarters at Wood's Holl, sending a special messenger along with them, and he has just returned, reporting their safe arrival at that point, where they were placed with the previous lots. We are keeping these fish in large salt water ponds, to see if it is possible to breed them there."

# SPENCER'S *ECCLESIASTICAL INSTITUTIONS.*

By R. F. GREEN.

It may fairly be predicted that Mr. Spencer's latest work will receive more popular attention than any preceding it. He has not hitherto written much for any but the thinking, in contradistinction to the existing, population, and his works have hitherto been as completely ignored by the latter as the most cynical pessimist could desire. But at last even little thinking folk have a volume within their reach which appeals to them in their every-day life as much as it does to the profoundest philosopher, and which, when it has passed through a necessary season of opprobrium, will probably be placidly accepted by them as true.

In *Ecclesiastical Institutions* we have the as yet most practical and familiar application of the theory of evolution. The preceding parts of the *Principles of Sociology*, on Ceremonial and Political Institutions, though useful to a much larger class than students of sociology, do not, and never can, from the nature of their subject, appeal so widely. Ecclesiastical institutions; though stripped as they have been throughout the western world, of much of their former power; still remain an important factor in our ethics, and the ideas and sentiments which have led to their development throughout the world may still be supposed to have interest for every one of us.

In his preface to the book, Mr. Spencer refers to the length of time which has elapsed since the appearance of its predecessor; the explanation he gives of the delay is one we all know to be unhappily the true one, ill-health; and he hints significantly of possible inability to do much more.

His friends and opponents—he has many of both, and many who are both—will alike hope that he may have strength left to complete the work he has set himself. It is a work the vastness and grandeur of which is difficult of realisation; but, whether completed or not, whether he may live to put the last pinnacle on that tower whose height above ordinary buildings has already made it the target for every theorist, it will remain an intellectual monument of which our descendants will know the value better than we can.

As is necessary before proceeding to trace the evolution of ecclesiastical institutions, Mr. Spencer calls our attention to the ideas and sentiments implied by them. They imply obviously the previous co-existence of religion, of religious ideas. And here, in default of any explicit definition given by Spencer of the word *religion*, I may say that throughout the *Principles of Sociology* he uses it as synonymous with *cult*, as referring to any system of belief which furnishes a guide to conduct, never as a word identified with piety or moral goodness.

Ecclesiastical institutions exist in societies. Their existence implies the existence of religious ideas. How are these latter to be accounted for? There are two theories possible. One that they are natural, innate, intuitive in man; and the other, that they are tuitive, acquired. The former theory, by far the more generally accepted, does not, of course, account for them; but if it is true, we are saved the trouble of accounting for them, their existence from the nature of the case being unaccountable. The latter before being accepted requires support by facts. If the religious idea is acquired, we should expect it absent in those who from any cause have not had the usual opportunities of acquiring it. As a matter of fact, we do find it absent in such persons; some savage nations, low in the scale of intelligence, seem entirely without religious ideas; and deaf mutes, who, until instructed

comparatively late in life, are precluded from conversation with their fellows, would seem to be equally deficient. From these facts mainly, Spencer comes to the conclusion that religious ideas are acquired. The next question is, how?

When a savage sees one of his companions asleep, he recognises an obvious change in his condition, the sleeper cannot hear or see and must be awakened before the usual communication between the two is possible—the sleeper is awakened, and waking describes a strange experience:—he says he has been in a strange country and was hunting, he saw his prey, gave chase, captured and killed it, just as he had often done in his own country. Being hungry, he skinned and cooked the animal, and was about to eat it when—everything changed, and he was back in his own land again and heard his companions call him. How had he so quickly been transported, and where? His companion tells him that he lay asleep; and, on the other hand, he is sure that he was away. He has not arrived yet at any idea of dreams, and his only way of accounting for the supposed change is that there is another part of himself besides his body, and that it is this other part, or double, which has been to the strange land and taken part in the hunt. On speaking to the other members of his tribe, he finds they have had many such experiences, and the belief in another self or double becomes general. But again, it is found that the occasions when this double seems absent vary considerably; sometimes, as after a wound or hurt, it is only away for a few moments, then, at night, many hours elapse before its return; and then there comes a time when it leaves the man and shows no sign of returning at all. What do his companions think then? They can only think of it as still wandering about in the strange dream-lands, and still liable to come back as it did before. If the dead man was a chief, his double will be thought of as still among them, and must

still be looked up to and obeyed. If they are successful in war or hunting he has helped them; if unsuccessful, he has been angry, as he was sometimes in life, and has not done so. The idea gains ground that, able to wander about from place to place at will as they know the double does when the man sleeps, it is more powerful than an ordinary man, and that, therefore, its assistance is more valuable. They endeavour to obtain its favour, to prevent its being angry, and so have the benefit of its constant assistance. This is *ghost propitiation*, the origin suggested by Spencer of the religious idea.

Of course, no such theory as this is tenable for a moment without the production of many facts in support of it, and just as the student of organic evolution finds in the existence of simpler forms of life, proofs of the development from them of the most complex, so Spencer finds in the customs of primitive societies, sufficient, if not ample, evidence that in ghost propitiation we have the embryo of religion. "*Comparative sociology discloses a common origin for each leading element of religious belief. The conception of the ghost, along with the multiplying and complicating ideas arising from it, we find everywhere—alike in the arctic regions and in the tropics; in the forests of North America and in the deserts of Arabia; in the valleys of the Himalayas and in African jungles; on the flanks of the Andes and in the Polynesian islands. It is exhibited with equal clearness by races so remote in type from one another, that competent judges think they must have diverged before the existing distribution of land and sea was established—among straight-haired, curly-haired, woolly-haired races; among white, tawny, copper-coloured, black. And we find it among peoples who have made no advances in civilization as well as among the semi-civilized and the civilized. Thus we have abundant proofs of the natural genesis of religions.*"

With this conclusion then as to the origin of religious

ideas, Spencer proceeds to enquire how they have developed in men's minds, and what has been the effect of their development upon societies. It will, of course, be impossible to give anything more than a rough outline of this process of ecclesiastical evolution as Spencer has shown it to us and we must omit any consideration of the numerous authorities he quotes. These will probably, however, be but little questioned. Spencer has seldom been accused of misstating facts, it is his conclusions from them that we are not always willing to accept.

To continue:—The dead man's double being thought of as still subject to the ordinary human consideration, must be taken care of. Food and clothing are given for its use at the funeral and afterwards, and we see thus originating the idea of sacrifice, "*one of the most universal and persistent in religions.*" Then there are presents to the double, and these are naturally laid upon the grave, passers-by making some small addition to them. In the case of a chief, where the presents are numerous, some preparation must be made for them, and we see altars beginning to develop. The grave is the place where the double may be supposed to frequent, and to which it will return, if it does return at all; it is, therefore, the resort of those who wish to communicate with the dead man. Partly for this reason, and partly as a protection to the offerings of food and so forth, a hut is built over the grave, and we have a religious edifice.

These grave-huts, built in unfrequented places, are likely to become the haunts of various animals, particularly night-birds and animals which, being disturbed by anyone's entrance, are naturally associated with the presence of the ghost. We have in this way a possible origin of the belief still current, that a dead ghost assumes the shape of animals, and also of the reverence for, and fear of, some of them.

The idea of the immortality of the double is not by any

means a primitive one, it is thought of as liable to injury and death, and its length of life seems to be variously conceived of by different races. "*Its habitat is also variously conceived*," sometimes it is thought of as present with the tribe, in other cases as inhabiting a certain fixed region more or less distant, but in all cases the idea is constant that it still influences its family and former companions, and that its influence, though generally beneficial, may be alienated unless duly propitiated.

We now take another step. "*Distinguishing but confusedly between semblance and reality, the savage thinks that the representation of a thing partakes of the properties of a thing. Hence he believes that the effigy of a dead man (originally placed on the grave) becomes a habitation for his ghost. That belief spreads to effigies otherwise placed, and we see savages offering them food and presents, with and without protestations and prayers.*" This is fetichism and there is a remarkable fact noticeable among tribes free from fetichism, that they seem utterly careless of their dead, and without any belief in ghosts.

But the identification of the dead ancestors with animals occurs also in another way, by confusion of metaphor:—A man is unusually strong and courageous, his companions compare him to a lion, call him "The young lion," he is known as the lion. When he dies, his memory is associated with a lion, and associated with it in a primitive language which makes the distinction between fact and metaphor, even when perfectly understood, very difficult to explain. "*In many ways the worship of animals arises, but all of them seem to imply identification with some human being.*

This theory of confusion of metaphor is, so far as I know, entirely new. It is one, I think, that will recommend itself to us more strongly the more we consider it, and it explains a number of well-known facts otherwise difficult to account

for—nature worship, for instance, and early mythologies become natural when we think of them as the metaphorical representation of ancestors. As a good example of this, Spencer instances the belief of some North Americans that "*The stars are camp fires made by the dead on their way to the other world.*" But when one of the tribe, "*pointing to a particular star originally thought of as the camp-fire of such or such a departed man, says 'There he is,' the children he is instructing naturally suppose him to mean that the star itself is the departed man; especially when receiving the statement through an undeveloped language.*"

But the ideas in connection with ghosts rapidly become differentiated, each family has its own ancestor worship, each tribe that of its chief, and while the propitiation of family ghosts for family benefits is undertaken by the head descendent in each family, the propitiation of the more important tribal ghost is naturally relegated to the head of the tribe. Then again, though the family and tribal ghosts are generally thought of as friendly, there are, to the particular tribe or family, other ghosts, such as those of family or tribal enemies, which are looked upon as more or less dangerous and which require to be guarded against. The power to do this need not be possessed by the chief or head of a family but may be credited to some other member of the tribe. His services, unlike those of the propitiator, which are regular and constant, are only called into requisition when required, and he becomes the "medicine-man," as distinguished from the primitive priest. The medicine-man, however, though he may in life become so powerful as to cause his ghost after his death to be propitiated and so originate a new cult, does not necessarily leave his power to his descendents, his influence becomes less as those who know him die, and he is gradually forgotten. Not so the primitive priest—"*his vocation is transmitted, and develops,*" as we shall see, "*an*

*organization often elaborate and a dominance sometimes supreme.*"

When a man dies, those most likely to perform propitiatory offices, to make offerings of food, clothing, and the like to his double, are his children and near kindred; other members of the tribe have less interest in him, less to fear or expect from his ghost. His children and kindred hoping to receive benefits proportionate to their propitiation, make these latter frequently, and we are shewn in them the beginning of a family religion. What is the next step? The family cult, ministered to at first by every member, gradually imposes its duties unequally, the propitiatory function devolves upon one member—the head or the eldest male descendant, and in the case of the co-existing tribal cult, it devolves similarly on the head of the tribe. The tribal ghost, as representing a more powerful person, and being more widely propitiated, comes to be thought more powerful, and his propitiator, besides being chief of the tribe, is its high priest, interceding not only for his own family but for all the tribe. "*The truth everywhere meets us, that the political and religious obligations are originally both obligations of allegiance, very little distinguished from one another, the one being allegiance to the living chief, and the other, allegiance to the ghost of the dead chief.*"

As a tribe grows larger, and its possessions increase, it becomes necessary for its chief to depute some of his functions, at first occasionally, then frequently, and afterwards permanently, to others. "*Among the functions thus deputed is that of priest.*" The chief's brother or sister, or one of his near kinsfolk, becomes propitiator for him. This is one origin of the separation of ruler and priest. Another and more decided separation may take place in consequence of the emigration of part of a tribe (in the cases where tribes continue undivided, little development of a priesthood is

likely to take place), the migrating portion, not being able readily to communicate with the priest, are prepared to accept the ministrations of persons akin to him, "*and, therefore, descendants, direct or collateral, of the worshipped god, and on one of these, in virtue of greatest age or nearest relationship, the function of high priest is likely to fall, and since the reasons which determine this choice tend also to determine inheritance of the function, the genesis of a priestly caste becomes intelligible.*"

The next point Mr. Spencer proceeds to consider is the development of polytheistic and monotheistic priesthoods. Wherever there exists in a tribe the worship of an apotheosized chief and the worship of an apotheosized ancestor, we have obviously an incipient polytheism and this incipient polytheism has, by the natural spreading of the tribe and the increase in it of the number of chiefs or powerful men, a tendency to increase and become more complex. Then there is conquest, which frequently takes place in savage nations, and which has one effect in imposing the cult of the conquering upon that of the conquered nation and of multiplying the varieties of priests; the reputation of a local god increases, as it did in the case of Æsculapius, and spreads to adjacent tribes; there *is the occasional apotheosis of those who strike the popular imagination as remarkable—all facts which make it clear that not only the genesis of polytheism, but its long survival, are sequences of primitive ancestor worship.* But polytheism carries with it its own destruction. The disciples of co-existing cults become jealous of each other's power, and efforts of subjugation—at first, when the cult is in process of organisation, slight and hardly noticeable, afterwards more and more powerful—are made; there arises a competition between them. *A feeling like that occasionally displayed by boys, boasting of the strength of their respective fathers, prompts*

*men in early stages to exaggerate the powers of their ancestors as compared with the powers which the ancestors of others displayed; and concerning the relative greatness of the deified progenitors of their tribes, there are certain to arise disputes.* Conquered nations naturally conclude that the gods of their victors are more powerful than their own; tribes dissatisfied with the rule of a chief, will desert him and attach themselves to another. In like manner, if dissatisfied with the result of their sacrifices and propitiations, they will give up the worship of one god for that of another. As the ghost of a dead man is believed like him, we find that human characteristics, such as anger, jealousy, revenge, are generally ascribed to it. *Ghosts not duly sacrificed to are conceived of as malicious, and as apt to wreak vengeance on survivors; gods, whose shrines have been neglected, and whose festivals do not bring due offerings, are said to be angry, and are considered the cause of disasters; while if one of them is derived from a ruler whose love of power was insatiable, he tends, if his devotees become predominant, to originate a worship which suppresses other worships. Of course, with such an advance towards monotheism, there goes an advance towards the unification of priesthoods. The official propitiators of minor duties dwindle away and disappear; while the official propitiators of the deity, who has come to be regarded as the most powerful, or as the possessors of all power, become established everywhere.*

*It may be observed, too, that once having been set up, the change towards monotheism goes on with increasing momentum among the highest intelligences. A supremacy of one supernatural agent having become established, there follows the thought that what power other supernatural agents exercise is exercised by permission. Presently they come to be conceived of as deputies, entrusted with powers not their own: and in proportion as the Cause of Causes grows more*

*prominent in thought, the secondary causes fade from thought.*

The development of polytheism into monotheism seems, however, not continuous; it shews a constant tendency to degenerate into a new polytheism by new apotheoses. Mahometanism is an instance,—originally a strongly monotheistic system, we see, in the numerous saints' shrines where worship takes place, a distinct departure from the original cult.

The political and ecclesiastical organisation of a society grow up side by side; the fact that one is little developed implies a correspondingly primitive character of the other, *and with a centralised coercive civil rule there goes a religious rule no less centralised and coercive;* so much so is this the case, that travellers among savage nations would wish us to believe that the extent of political slavery was in direct ratio to the number of churches. The two organisations have a common origin; when the chief was the political as well as the religious head, obedience to the gods involved obedience to him, and *it is only when the affairs of this world begin to be thought of as distinct from the affairs of the supposed other world, that the separation of the political from the ecclesiastical organisation is possible.*

But a highly developed religious organisation implies an increase in the priesthood; this priesthood develops, and in process of time becomes differentiated by the creation of degrees in the priestly office, and eventually leads to the establishment of a more or less complete ecclesiastical hierarchy.

*Among leading traits in the development of ecclesiastical institutions have to be added the rise and establishment of monasticism,* and of this again the ghost theory furnishes us with a clue. The chief of a savage family dies; at his funeral and on his grave are offered food and clothing, both

being thought necessary to his ghost. The gift of these often implies the fasting or discomfort of the giver, and the greater his discomfort the more will he think he is pleasing and propitiating the double. By and by the ideas of the cause of the discomfort become confused with the discomfort itself, and he imagines that the latter is pleasing to the ghost. *All over the world, ascetic practices have thus originated.*

There is, however, another origin of them: —fasting is frequently adopted by savages to bring on the abnormal mental states and vivid dreams which they think put them into communication with spirits. In such states persons are looked upon with awe by their companions, who come to regard those most frequently in them as most worshipful. The Ascetic makes his appearance in every religion which reaches any considerable development, and we may trace their increase in number and subsequent organization just as in the case of priests.

Having followed the development from primitive ideas of ecclesiastical institutions common to all religious systems, Mr. Spencer proceeds to the consideration of the effect they have had upon society:—When a savage dies and his ghost is propitiated as a man, the orders he gave and the line of conduct he pursued are likely to be carried out unchanged by his descendants. A change would be displeasing to him and, therefore, when it can possibly be avoided, no change is made. Again, his funeral and the propitiatory ceremonies subsequent to it, involve the presence of his descendants, and have a tendency to keep them together, and to strengthen, consequently, the social ties. At such ceremonies, family quarrels—not so rare then as now—would be repressed, the dead man's wishes or instructions would be discussed and applied to existing affairs, in fact a general co-operative influence would be exerted. This is one result of the develop-

ment of ecclesiastical institutions; another has been the regard for proprietary rights.

Commencing with offerings on graves, which obviously were sacred from appropriation or molestation, the principle of taboo extended to things intended for sacrifice—certain young animals, portions of a crop, etc.—these being denoted by a mark. But *obviously a sacredness thus given to anything bearing a sign that it belongs to a god, may easily be simulated. Though the mark on an animal or a fruit implies that an offering to a god will eventually be made of it; yet, since the time of sacrifice is unspecified, there results the possibility of indefinite postponement, and this gradually opens the door to pretended dedication of things which never are sacrificed—things which, nevertheless, bearing the sign of dedication, no one dares meddle with.* This system of *taboo* is, in fact, carried out and observed to a ridiculous extent among many semi-civilized tribes.

*The general influence of ecclesiastical institutions is conservative in a double sense. In several ways they maintain and strengthen social bonds and so conserve the social aggregate, and they do this in a large measure by conserving beliefs, sentiments, and usages which, evolved during earlier stages of the society, are shewn by its survival to have had an approximate fitness to the requirements, and are likely still to have it in great measure.* We have this exemplified in our own time by the persistence of ancient implements for sacred purposes, the retention of archaic languages in religious ceremonies, and the like. *Looking at it generally, we may say that ecclesiasticism stands for the principle of social continuity. Above all other agencies it is that which conduces to cohesion; not only between the coexisting parts of a nation, but also between its present generation and its past generations. In both ways it helps to maintain the individuality of the society. Or, changing somewhat the*

*point of view, we may say that ecclesiasticism, embodying in its primitive form the rule of the dead over the living, and sanctifying in its more advanced forms the authority of the past over the present, has for its function to preserve in force the organised product of earlier experiences versus the modifying effects of more recent experiences. Evidently this organised product of past experiences is not without credentials. The life of the society has, up to the time being, been maintained under it, and hence a perennial reason for resistance to deviation. If we consider that, habitually, the chief or ruler, propitiation of whose ghost originates a local cult, acquired his position through successes of one or other kind, we must infer that obedience to the commands emanating from him, and maintenance of the usages he initiated, is, on the average of cases, conducive to social prosperity so long as conditions remain the same; and that, therefore, this intense conservatism of ecclesiastical institutions is not without a justification.*

*Even irrespective of the relative fitness of the inherited cult to the inherited social circumstances, there is an advantage in, if not indeed a necessity for, acceptance of traditional beliefs, and consequent conformity to the resulting customs and rules. For before an assemblage of men can become organized, the men must be held together, and kept ever in presence of the conditions to which they have to become adapted; and that they may be thus held, the coercive influence of their traditional beliefs must be strong. So great are the obstacles which the anti-social traits of the savage offer to that social cohesion which is the first condition to social progress, that he can be kept within needful bonds only by a sentiment prompting absolute submission—submission to secular rule reinforced by that sacred rule which is at first in unison with it. And hence, as I have before pointed out, the truth that, in whatever place arising—Egypt, Assyria, Peru,*

*Mexico, China—social evolution throughout all its earlier stages has been accompanied, not only by extreme subordination to living kings, but also by elaborate worships of the deities originating from dead kings.* But, as before, when the development of an essentially antagonistic monotheism was shewn from an increasing polytheism; so now the social bond of ecclesiasticism develops and breaks in its development:—whereas, in primitive societies we see social, political, and religious headship identical, and a correspondingly complete assimilation of these three elements themselves; as men advance in the social scale, there is an equally gradual differentiation of these elements until they become distinct, and to a great extent independent ethical factors, and begin to compete together for supremacy. In the early part of the struggle the weaker influences become subordinate, and the contest in most societies has remained between religion and politics, between the Church and State.

This, Mr. Spencer shews us is the contest now going on, and of which he ventures to foreshadow the issue. At first all things combined to give the advantage to ecclesiasticism, priests were advisers, counsellors; they crowned kings, controlled wars, inflicted punishments, they were the cultured class and taught the young—an office sufficient of itself to make them almost supreme—they alone had the art of writing, and were thus able to co-operate more readily; and last, they had accumulated a vast amount of property and wealth with its corresponding control of labour. *Holding in its hands powers natural and supernatural thus great and varied, an ecclesiastical organization seems likely to be irresistible, and in sundry places has proved irresistible. Where the original blending of Church and State has given place to that vague distinction arising from partial specialization of function accompanying social evolution, there are certain to arise differences of aim between the two, and a consequent*

*question whether the living ruler, with his organization of civil and military subordinates, shall or shall not yield to the organization of those who represent dead rulers and profess to utter their commands.'*

The struggle needs no exemplification. Alike in the jealousy of a savage chief for the tribe's medicine man, in the civil wars of mediæval Europe, and in modern Nonconformity, we see the contest between political and ecclesiastical institutions. That the influence of the former is predominating will hardly be questioned, and it is interesting to notice how, according to Mr. Spencer, this has come about. *There are reasons for thinking that the change from an original predominance of the spiritual power over the temporal power to ultimate subjugation of it, is mainly due to that cause which we have found in other cases chiefly operative in determining the higher types of social organization—the development of industrialism.*

*Already we have noted that, while their extreme servility of nature made the peoples of ancient America yield unresistingly to an unqualified political despotism appropriate to the militant type of society, it also made them submit humbly to the enormously developed priesthoods of their bloody deities; and we have seen that kindred connections of traits were shown by various races of the old world in past times. The contrast with other ancient peoples presented by the Greeks, who, as before pointed out, were enabled by favouring conditions to resist consolidation under a despot, at the same time that, especially in Athens, industrialism and its arrangements made considerable progress among them, must here be joined with the fact that there did not arise among the Greeks a priestly hierarchy. And the connection thus exemplified in classic times between the relatively free institutions proper to industrialism, and a smaller development of the sacerdotal organization, is illustrated throughout Europeon history,*

*alike in place and in time. The common cause for these simultaneous changes is, as above implied, the modification of nature caused by substitution of a life carried on under voluntary co-operation for a life carried on under compulsory co-operation—the transition from a social state in which obedience to authority is the supreme virtue, to a social state in which it is a virtue to resist authority when it transgresses prescribed limits.*

*The attitude of mind fostered by this discipline does not favour unqualified submission, either to the political head and his laws, or to the ecclesiastical head and his dogmas. While it tends ever to limit coercive action of the civil ruler, it tends ever to challenge the authority of the priest; and the questioning habit having once commenced, sacerdotal inspiration comes to be doubted, and the power flowing from belief in it begins to wane.*

*With this moral change has to be joined an intellectual change, also indirectly resulting from development of industrial life. That spreading knowledge of natural causation which conflicts with, and gradually weakens, belief in supernatural causation, is consequent on development of the industrial arts. This gives men wider experiences of uniformities of relation among phenomena; and makes possible the progress of science. Only as fast as knowledge of the natural order becomes so familiar and so generally diffused as insensibly to change men's habits of thought, is sacerdotal authority and power diminished by it; and general diffusion of such knowledge is, as we see, a concomitant of industrialism.*

Here, at last, is suggested the final question; What is to be the result of these changes? If ecclesiastical institutions have originated and developed in accordance with the laws of evolution, if their present existence is, as Mr. Spencer says it is, the direct result of these laws—what are their prospects

in the future? And what—for we cannot help asking ourselves the further question also—what will be the future development of the religious idea? As may be supposed, these enquiries are not evaded, although an answer to them is necessarily vague. *That separation of ecclesiastical from political institutions, foreshadowed in simple societies when the civil ruler begins to dispute occasionally his priestly function, and which, in many ways, with many modifications, according to their types, societies have increasingly displayed as they have developed, may be expected to become complete. The same emotional and intellectual modifications which, while causing the diminished power of State-churches, has caused the multiplication of churches independent of the State, may be expected to continue hereafter doing the like. We may look for increased numbers of religious bodies having their respective differences of belief and practice. Though, along with intellectual advance, there may probably go, in the majority of sects thus arising, approximation to a unity of creed in essentials; yet analogy suggests that shades of difference, instead of disappearing will become more numerous.*

*Divergencies of opinion like those which, within our generation, have been taking place in the established church, may be expected to arise in all existing religious bodies, and in others hereafter formed. . . . And along with the acquirement of complete autonomy by each religious body, there is likely to be a complete loss of the sacerdotal character by any one who plays the part of minister. That relinquishment of priestly authority which has already gone far among Dissenters, will become entire.*

*Leaving structures, and turning to functions, it remains to ask—What are likely to be the surviving functions, supposing the evolution which has thus far gone on is not reversed? Each of the two functions above described may be expected to continue under a changed form.*

*Though with the transition from dogmatic theism to agnosticism, all observances implying the thought of propitiation may be expected to lapse; yet it does not follow that there will lapse all observances tending to keep alive a consciousness of the relation in which we stand to the Unknown Cause, and tending to give expression to the sentiment accompanying that consciousness.*

*There will remain a need for qualifying that too prosaic and material form of life which tends to result from absorption in daily work, and there will ever be a sphere for those who are able to impress their hearers with due sense of the mystery in which the origin and meaning of the universe are shrouded. It may be anticipated, too, that musical expression to the sentiment accompanying this sense will not only survive, but undergo further development. Already Protestant cathedral music, more impersonal than any other, serves not unfitly to express feelings suggested by the thought of a transitory life, alike of the individual and of the race—a life which is but an infinitesimal product of a power without any bounds we can find or imagine; and hereafter, such music may still better express these feelings. At the same time, that insistance on duty, which has formed an increasing element in religious ministrations, may be expected to assume a marked predominance and a wider range. . . All matters concerning individual and social welfare will come to be dealt with; and the chief function of one who stands in the place of a minister will be not so much that of emphasizing precepts already accepted, as that of developing men's judgments and sentiments in relation to those more difficult questions of conduct arising from the ever-increasing complexity of social life.*

*In brief, we may say that, as there must ever continue our relations to the unseen and our relations to one another, it appears not improbable that there will survive certain repre-*

*sentatives of those who, in the past, were occupied with observances and teachings concerning these two relations; however unlike their sacerdotal prototypes such representatives may become.*

With regard to the prospective development of the religious ideas underlying ecclesiastical institutions, one word will express Mr. Spencer's foreshadowing—"*de-anthropomorphism.*" From the time when the savage, first murdering a war prisoner on his chief's grave, believed he was propitiating to the pleasure and passion of another man like, and only stronger than, the dead one, to the present day; there has gone on a process of etherealization. One after another, by one race after another, as they develop in intelligence, the gross anthropomorphic accompaniments of religious belief have been rejected, and are still in process of rejection. Some still cling to it, some, indeed, shew little sign of disappearing in our time, but the future prospect evolution shews us is silence—an increasingly inexpressible reverence as we consider the power on all sides surrounding us.

Is such an agnosticism yet possible for the majority of men? Obviously not, as is shown us by the retention of more material forms of belief. If the ultimate religious idea is a consciousness, unsymbolizable in language, it can hardly be a motive or guide of conduct. It cannot, in fact, be religion at all in our sense of the word, and it is hard to see how the existence of ecclesiastical institutions, in any form, can be compatible with it. *But one truth must grow ever clearer; the truth that there is an inscrutable existence everywhere manifested, to which we can neither find nor conceive either beginning or end. Amid the mysteries which become the more mysterious the more they are thought about, there will remain the one absolute certainty—that we are ever in presence of an infinite and eternal energy from which all things proceed.*

One rises from the study of Mr. Spencer's book with feelings it is by no means easy to analyse. Its conclusions are undoubtedly subversive, to a great extent, of generally received ideas, and yet they are conclusions arrived at by a method apparently unimpeachable. We are carried along, by a style almost irresistible, from one stage of argument to another, and only realize how far we have travelled when we find ourselves shrinking from the inferences which confront us. That Mr. Spencer's knowledge is so wide makes us hesitate as it were in our comparative ignorance to follow him. That he has set himself the always dangerous task of fitting general principles to existing facts, makes us ever suspicious that both are most strained when they most perfectly harmonize. He seems to inspire caution at the same moment as confidence, to compel faith no less than fear. His merciless attacks on what we believe to be false, make us shudder when he approaches what we feel is true. Authority influences his opinion no more than party does his politics, he is as careless of custom as he is of creed, and as free from sentiment as from prejudice. There is no man in our time, except Darwin, who has shewn such genius in collecting and correllating facts. Historians, missionaries, travellers, explorers, seem almost to write for him, so great is the use he makes of their work and so wonderful is his power of generalisation. He is like a giant, who, in a virgin forest, can see the way, marked out by great trees, clearly before him; while ordinary men, misled by twisting branches, struggle hopelessly and lose themselves in the tangled underwood below.

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LORD STREET.

*L. M. B. C. REPORTS. No. I.*

# THE FIRST REPORT

UPON THE

# FAUNA OF LIVERPOOL BAY

AND THE

# NEIGHBOURING SEAS,

WRITTEN BY THE MEMBERS OF THE

LIVERPOOL MARINE BIOLOGY COMMITTEE,

AND EDITED BY

W. A. HERDMAN, D.Sc., F.L.S.,
PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

*WITH TEN PLATES AND TWO MAPS.*

LONDON:
LONGMANS, GREEN & CO.
1886.

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# INTRODUCTION.

It seems desirable to make a brief statement in regard to the mode of origin and the objects of the Liverpool Marine Biology Committee as an introduction to this First Report on the Fauna of Liverpool Bay.* As the result of an informal conversation with some of the local naturalists, an address was given on March 6th, 1885, by Professor Herdman to the members of the Liverpool Microscopical Society, pointing out some of the characteristics of the Marine Fauna, and urging the necessity for an exploration of the estuary of the Mersey. In consequence of the discussion which took place on this occasion, the following circular was shortly afterwards sent out to members of the local scientific societies and others likely to be interested in the matter:—

"MARINE BIOLOGY.

A Meeting will be held in the Zoological Laboratory, University College, Liverpool, on Saturday, March 14th, at 8 p.m., to discuss the proposed scheme for a thorough investigation of the Fauna and Flora of the neighbouring seas.

W. A. Herdman."

This meeting was attended by representatives of the scientific societies and museums of Liverpool, Manchester, and Chester, and by a number of the local naturalists. After a considerable amount of discussion it was unanimously resolved "that steps should be taken to investigate the Marine Biology of Liverpool Bay during the coming summer, with the view of compiling a 'Fauna' of the neigh-

* The L. M. B. C. District, or Liverpool Bay in a wide sense, is that part of the Irish Sea bounded by the coast of Lancashire, the north coast of Wales, and the Isle of Man.

bourhood, the arrangement of details being left in the hands of a small committee." The following gentlemen were then appointed as the Liverpool Marine Biology Committee:—

F. ARCHER, Esq., B.A., Crosby.

R. D. DARBISHIRE, Esq., B.A., F.G.S., Manchester.

R. J. HARVEY GIBSON, Esq., M.A., F.R.S.E., University College, Liverpool.

Professor HERDMAN, D.Sc., F.R.S.E., F.L.S., University College, Liverpool.

Rev. H. H. HIGGINS, M.A., Free Public Museum, Liverpool.

A. LEICESTER, Esq., Waterloo.

Professor A. MILNES MARSHALL, D.Sc., F.R.S., Owens' College, Manchester.

T. J. MOORE, Esq., C.M.Z.S., Curator, Free Public Museum, Liverpool.

JAMES POOLE, Esq., J.P., Liverpool.

ISAAC ROBERTS, Esq., F.G.S., Maghull.

I. C. THOMPSON, Esq., F.R.M.S., Liverpool.

A. O. WALKER, Esq., F.L.S., Chester.

This Committee resolved to make arrangements for—

1st, organising dredging, tow-netting, and other collecting expeditions;

2nd, the examination and description of the specimens obtained; and,

3rd, the publication of the results.

It was intended at first to obtain subscriptions from those interested in the work for the purpose of hiring a steam-tug for the dredging expeditions, but, owing to the liberality of a few gentlemen in placing suitable vessels at the disposal of the Committee, that step has not yet been found necessary.

Early in April, a letter was received from Mr. GEORGE HOLT offering to provide a steam-tug for the first dredging

expedition of the Committee. The expedition took place on the 9th of May, in the tug "Merry Andrew," chartered by Mr. Holt, and was attended by most of the members of the Committee and a few other naturalists. After some unsuccessful hauls of the dredge in the Rock Channel,* opposite Bidston Lighthouse, at a depth of five fathoms, on a sandy bottom, when only a few Zoophytes and Polyzoa were obtained, the "Merry Andrew" proceeded to Hilbre Swash, the deep channel which runs northwards from Hilbre Island, at the eastern mouth of the river Dee, and there dredging, trawling, and tow-netting operations were carried on during the remainder of the day. Hilbre Swash is the deepest part of the area of Liverpool Bay inside the Bar Lightship, depths of nine, ten, and eleven fathoms being frequently found in it. The bottom varies from a fine stiff grey mud to sand and gravel, with occasional lumps of coarse red sandstone, more or less covered with Hydroids, Polyzoa, Sponges, and other incrusting animals. The most prolific locality examined was found to be a spot close to the north-west end of Hilbre Island, at a depth of ten fathoms.

The more important species obtained in this expedition were the following:—†

Cœlenterata.—*Hydractinia echinata*, *Tubularia indivisa*, *Garveia nutans*, *Calycella syringa*, *Sertularia filicula*, *Actinoloba dianthus*, and *Alcyonium digitatum*.

Polyzoa.—*Crisia eburnea*, *Cellepora pumicosa*, *Idmonea serpens*, *Flustra foliacea*, *Scrupocellaria scrupea*, *Amathia lendigera*, *Gemellaria loricata*.

Polychæta.—*Sabella penicillus*, *Serpula vermicularis*.

* For this and the other localities mentioned, see the accompanying Chart (Pl. XI).

† Preliminary accounts, giving the results of the various expeditions, have been published in the Liverpool papers. See *Liverpool Daily Post*, May 11, May 28, June 15, June 22, July 14.

CRUSTACEA.—*Caprella linearis*, *Pagurus bernhardus*, *Porcellana longicornis*, and *P. platycheles*, *Hyas araneus*, *Portunus depurator*, and *Stenorhynchus rostratus*.

MOLLUSCA.—*Pholas candida*, *Ancula cristata*, *Tritonia plebeia*, *Doto coronata*.

In the tow nets, *Pleurobrachia*, Medusoid Gonophores (chiefly species of *Thaumantias*), and Copepoda were taken in great abundance. The specimens collected were all brought to the Zoological Laboratory of University College, and were there roughly arranged in groups, preserved in alcohol or picric acid solution, labelled, and stored away.

The most important result of this expedition was, undoubtedly, the discovery of *Garveia nutans*. This rare Zoophyte * had not been previously found in this neighbourhood, although the investigations of the Liverpool Marine Biology Committee have shown that it is widely distributed over the area, and, apparently, is fairly abundant in the neighbourhood of Hilbre Island.

About the middle of May, a letter was received from Mr. N. RUNDELL, Jun., offering, on behalf of the Liverpool Salvage Association, to allow the Marine Biology Committee to have the use of the S.S. "Hyæna" for a three days' cruise along the coast of North Wales. This afforded a welcome opportunity for investigating one of the more outlying parts of the district which could not be overtaken in a single day's expedition; so it was decided that the region in the neighbourhood of the Great Ormes Head, Puffin Island, and the entrance to the Menai Straits, should be specially explored. About twenty naturalists took part in the expedition, which occupied three complete days, the 23rd, 24th, and 25th of May. Between thirty and forty hauls of the dredge and trawl

* See *Report upon the Hydroida*, p. 99.

were taken during this cruise of the "Hyæna," and the collection of animals obtained was very considerable.

On the 23rd May, the dredge was first let over on the western end of the Constable Bank, near Llandudno. At this spot three hauls were taken in depths of from six to seven fathoms, resulting in the capture of various species of Hydroids and Polyzoa, *Pectinaria belgica, Corystes cassivelaunus, Thia polita,* and *Loligo media.* Later on in the same day, several hauls of the trawl were taken a short distance off the Great Ormes Head, in depths of from seven to eight fathoms. Amongst the animals obtained were :—

Hydroida.—*Coppinia arcta, Tubularia indivisa.*

Polychæta.—*Sabellaria alveolata.*

Echinodermata. — *Solaster papposa, Echinocyamus pusillus, Echinocardium cordatum, Cucumaria pentactes.*

Crustacea.—*Hyas coarctatus, Stenorhynchus rostratus, Pilumnus hirtellus,* and *Portunus depurator.*

Mollusca.—*Mactra solida* (large), *Mactra stultorum* (pale variety), *Anomia patelliformis, Pecten pusio, Pecten varius, Pholas candida, Trochus zizyphinus, Pleurotoma turricula, Fusus gracilis, Murex erinaceus,* and *Dendronotus arborescens.*

On the 24th of May, operations were commenced to the north of Puffin Island,* where several successful hauls were taken in depths of from eleven to fourteen fathoms.

Amongst other species obtained in this locality were :—

Crustacea.—*Mysis spiritus, Pandalus brevirostris, Hippolyte cranchii, Crangon trispinosus* and *C. fasciatus, Hippolyte pusiola, Portunus corrugatus* and *Eurynome aspera.*

Pycnogonida.—*Pephredo hirsuta* (?), *Achelia echinata*

* See *Chart,* Pl. XI.

and *A. hispida, Phoxichilidium femoratum, Phoxichilus spinosus.*

MOLLUSCA.—*Doto coronata, Doto fragilis, Eolis gracilis, Mytilus barbatus, Anomia patelliformis,* and *Sepiola atlantica.*

Later on in the day, in the Menai Straits, nearly opposite Bangor, at a depth of about ten fathoms, the small red Ascidian, *Styela grossularia,* was obtained in quantity. Specimens of *Ascidia virginea, Polycyclus savignyi,* and *Alcyonidium gelatinosum* were also obtained in the Straits, along with many dead shells.

On the morning of the 25th, the third day of the cruise, a few hauls of the dredge were taken in fourteen fathoms, between Puffin Island and Anglesea. In this channel, *Ophiothrix pentaphyllum* must be very abundant since it came up in dredgefuls. Amongst the Mollusca obtained here were:—*Modiola barbata, Sphenia binghami, Scrobicularia prismatica, Scrobicularia alba, Tellina donacina, Saxicava rugosa, Cardium norvegicum,* and *Eledone cirrhosa.*

The trawl was then let down off Red Wharf Bay, on the north coast of Anglesea, but resulted in little worthy of note except *Dentalium entale* and a large specimen of *Eolis picta.* On the way back to Liverpool, a few hauls were taken in fourteen fathoms, about six miles to the north of the Great Ormes Head. Here a large specimen of *Astropecten irregularis* was obtained, with the rare Annelid *Malmgrenia castanea* * as a commensal in one of the ambulacral grooves. Amongst the other species observed were:—

HYDROIDA —*Garveia nutans, Campanularia verticillata, Sertularella polyzonias* and *Sertularia operculata.*

POLYZOA.—*Vesicularia spinosa.*

TUNICATA.—*Botrylloides rubrum.*

* See *Report upon the Vermes,* p. 149.

POLYCHÆTA.—*Aphrodite aculeata.*

MOLLUSCA.—*Lima loscombii* and *Corbula gibba.*

The most important forms obtained during the cruise of the "Hyæna" were:—*Garveia nutans, Cucumaria pentactes, Malmgrenia castanea, Mysis spiritus, Thia polita, Pilumnus hirtellus, Pandalus brevirostris, Eolis gracilis, Eolis picta, Sepiola atlantica,* and *Loligo media.*

The tow-nets were used frequently, capturing Medusoid Gonophores, *Pleurobrachia,* many Copepoda, and various larval forms (chiefly Crustacea).

During May, June, and July, several expeditions were organised to explore Hilbre Island and the neighbourhood at low tides. These were largely attended, and very considerable collections have been formed of the species living between tide marks on the shore.

Hilbre Island is well known amongst the local naturalists on account of its comparatively rich marine fauna. It is certainly the most interesting spot in Liverpool Bay from a biological point of view, and it would be the most suitable locality, within a reasonable distance from Liverpool, for the establishment of a marine laboratory for carrying on biological investigations.

The rocks at the northern end of the Island are covered at and about low water mark by a rich and varied assemblage of invertebrate animals, and form a particularly favourable locality for certain Hydroid Zoophytes, Actiniæ, Polyzoa, and Nudibranchs. A complete account of the fauna of Hilbre Island, with a description of the conditions, so far as they are known, under which the various species live, is one of the objects which the Liverpool Marine Biology Committee have set before them, and it will probably form a considerable part of one of their future Reports.

Among the more important species which were found

last summer on the shores of Hilbre Island are the following:—

PORIFERA.—*Sycandra ciliata, Isodictya varians, Suberites carnosa, Halisarca dujardinii.*

CŒLENTERATA.—*Clava multicornis, Garveia nutans, Tubularia indivisa, Tubularia larynx, Coryne pusilla, Obelia dichotoma, Sertularella rugosa, Actinoloba dianthus*, var. *rubida, Cylista undata.*

ECHINODERMATA.—*Echinus esculentus, Asterias rubens, Echinocyamus pusillus.*

POLYCHÆTA.—*Sabellaria alveolata, Sabella penicillus, Siphonostomum gelatinosum, Pectinaria belgica.*

POLYZOA.—*Pedicellina cernua*, var. *glabra, Bowerbankia imbricata, Anguinella palmata, Bugula flabellata* and *B. turbinata, Flustra foliacea, Bicellaria ciliata, Amathia lendigera.*

PYCNOGONIDA.—*Pycnogonum littorale, Phoxichilus spinosus.*

CRUSTACEA.—*Hyas araneus, Stenorhynchus rostratus, Porcellana platycheles, Mysis flexuosa, Caprella linearis.*

MOLLUSCA.—*Tapes pullastra*, var. *perforans, Pholas crispata, Eolis despecta, Eolis drummondi, Eolis coronata, Eolis nana, Ancula cristata, Doto coronata, Dendronotus arborescens, Tritonia plebeia, Doris pilosa, Eledone cirrhosa.*

TUNICATA.—*Ciona intestinalis, Clavelina lepadiformis.*

The specimens of *Garveia nutans* were found living, and with gonophores, on June 13th, attached to the rocks just beyond low water mark at the north end of the Island, exactly opposite the spot in Hilbre Swash where the species was dredged on the "Merry Andrew" expedition, on May 9th.

It is intended during next summer to divide the littoral

zone at Hilbre into a series of regions or sub-zones, separated by contour lines parallel with low water mark, and to investigate the fauna and flora of each region separately, so as to determine their characteristic animals and seaweeds, and the relative capacities the different species possess for withstanding exposure to air and sunshine. *Flustrella hispida* was found, last summer, attached to the rock, within about one yard of high water mark, in a living and healthy condition. From its position, this animal can only be immersed in water during a small proportion of its life, at and about the time of high tide. It will be interesting to discover whether it shares this condition with other marine animals and to determine the nature of the food in such cases, and whether the species is able to stand considerable variation in the amount of its periodic exposure to air.

On some parts of the Hilbre shore, especially at the northern end where sand and rock meet, a gregarious tubicolous annelid, *Sabellaria alveolata,* is present in great abundance, and produces, by building up tubes formed of sand-grains, a loose, porous, but crisp and brittle, mass, which crumbles when walked upon, but which is constantly being renewed, and has its injuries repaired by the living annelid within. This, from its abundance and thickness, must have a very considerable effect in protecting the shore from the erosive action of the sea. The masses, hummocks, plateaux, ledges, and small reefs of this rock-building annelid, have often a curious external resemblance, superficial only, of course, to the forms produced by coral masses amongst coral reefs and islands. It might be possible, by a continuous study on the spot of this *Sabellaria* at Hilbre, to determine what part the various factors—food, currents, muddy water, presence of sand and rock, exposure to waves, and arrangement of animals in the mass—take in producing the different shapes, and in favouring and retarding growth.

A considerable amount of variation was noticed in the relative numbers of certain species at the various expeditions to Hilbre Island. As an example, the large *Dendronotus arborescens* was almost absent from the shore early in the summer (May), while in July it occurred in abundance. This suggests that there is possibly a considerable amount of migration from deep water on to the shore, and back again, in the case of some species of molluscs and other animals.

The discovery of *Clavelina lepadiformis* at Hilbre is interesting, as the Tunicata seem particularly rare in this neighbourhood. *Clavelina* was dredged in abundance, during August, off the south end of the Isle of Man, in deep water.

In the middle of June, Mr. JAMES POOLE, a member of the Committee, offered to provide a tug, the "Spindrift," for a dredging expedition on the 20th of June. The channel between Hilbre Island and Point of Ayr, on the Welsh coast, was chosen for exploration on this occasion, and, notwithstanding very unfavourable weather, a considerable amount of work was done. Dredging, trawling and tow-netting were carried on in Hilbre Swash, in Welshman Gut, and in a deep hole lying a short distance off Point of Ayr. In this last locality, the following species amongst others were obtained:—

COELENTERATA.—*Hydractinia echinata, Halecium halecinum, Alcyonium digitatum, Actinoloba dianthus, Lafoëa dumosa, Sertularia abietina, Sertularia operculata, Sertularia filicula, Antennularia antennina.*

POLYZOA.—*Idmonea serpens, Scrupocellaria scrupea, Amathia lendigera, Crisia eburnea, Alcyonidium gelatinosum.*

CRUSTACEA.—*Montagua alderi, Caprella linearis, Mysis*

*spiritus, Pagurus bernhardus, Galathea intermedia, Portunus arcuatus.*

MOLLUSCA.—*Natica catena, Tellina tenuis, Sepiola atlantica.*

Surface organisms seemed to be almost confined on this occasion to *Noctiluca miliaris*, a few Copepoda, and vast quantities of a small spherical gelatinous Alga. This last organism was met with again, later on in the summer, by Mr. THOMPSON, at Penmaenmawr.*

Probably the region at the mouth of the Dee, lying between Hilbre Island and the Point of Ayr, will prove a very good dredging locality, when carefully investigated under more favourable circumstances.

It was thought desirable by the Liverpool Marine Biology Committee that the marine fauna at the extreme limits of the Liverpool Bay district † should be investigated, and collections made at these places, so that comparisons might be instituted with the faunas of Hilbre Island and of the immediate neighbourhood of the Mersey. Consequently one of the members of the Committee conducted dredging and tow-netting observations for several weeks in July, in the neighbourhood of Penmaenmawr, and another member spent five weeks in July and August in continuous dredging and collecting along the southern end of the Isle of Man. For a detailed account of these observations, reference may be made to the separate Reports upon these outlying localities.‡

Several Ascidians (*Ascidia virginea, Ascidia scabra, Styela grossularia* and *Botrylloides rubrum*), which had not been previously obtained in the district, were found at Penmaenmawr.

* See *Report upon Fauna of Penmaenmawr*, p. 315.

† The western limits are the Isle of Man to the north and Anglesea to the south.

‡ See *Report on Fauna of Penmaenmawr*, by I. C. Thompson, F.R.M S., p. 315; and *Report on Fauna of Isle of Man*, by Prof. Herdman, D.Sc., p. 318.

Amongst the other more notable species observed were *Aglaophenia pluma*, *Vermilia triquetra*, *Thelepus circinatus*, *Amathia lendigera*, *Bugula flabellata*, *Philine aperta*, and *Pycnogonum littorale*.

The marine fauna at the south end of the Isle of Man was found to be particularly rich, and a number of rare species were collected, amongst which were the following:—

PORIFERA.—*Halisarca dujardinii*, *Hymeniacidon sanguinea*, *Cliona celata*, *Dictyocylindrus stuposus*, *Chalina limbata*, *Isodictya elegans*, *Halichondria incrustans*, *Leucandra gossei*, *Leucandra nivea*, *Leucandra johnstonii*, *Leucandra fistulosa*, *Ascetta coriacea*.

CŒLENTERATA.—*Garveia nutans*, *Campanularia hincksii*, *Campanularia caliculata*, *Plumularia pinnata*, *Corynactis viridis*, *Polythoa arenacea*, *Sarcodictyon catenata*, *Halcampa chrysanthellum*, *Adamsia palliata*, *Heliactis venusta*, *Bunodes gemmaceus*, *Bougainvillea britannica*, *Thaumantias octona*, *Thaumantias thompsoni*, *Tubularia simplex*.

ECHINODERMATA.—*Antedon rosaceus*, *Asterina gibbosa*, *Ocnus brunneus*, *Cucumaria hyndmanni*.

POLYCHÆTA.—*Hermadion assimile*, *Hermione hystrix*, *Harmothöe haliæti*, *Sthenelais zetlandica*, *Sagitta bipunctata*, *Filograna implexa*.

POLYZOA. — *Pedicellina gracilis*, *Cellaria fistulosa*, *Schizoporella hyalina*, *Membranipora aurita*, *Umbonula verrucosa*, *Mimosella gracilis*, *Ætea truncata* and *Æ. recta*, *Mucronella coccinea*, *Eucratea chelata*, var. *elongata*, nov.

CRUSTACEA.—*Proto pedata*, *Inachus dorsettensis*, *Eurynome aspera*, *Ebalia tuberosa*, *E. tumefacta* and *E. cranchii*, *Pagurus cuanensis*.

PYCNOGONIDA.—*Pephredo hirsuta* (?), *Phoxichilus spinosus*, *Phoxichilidium femoratum*.

MOLLUSCA.—*Pectunculus glycimeris*, *Lima loscombii*, and *L. elliptica*, *Pecten tigrinus*, var. *costata*, *Modiolaria marmorata*, *Fissurella græca*, *Dentalium entale*, *Trivia europæa*, *Trochus zizyphinus*, *Phasianella pullus*, *Pleurobranchus membranaceus*, *Aplysia punctata*, *Eolis picta*, *Eolis amœna*, *Eolis tricolor*, *Goniodoris castanea*. *Astarte sulcata*, *Venus casina*, *Thracia prætenuis*.

TUNICATA.—*Botryllus violaceus*, *Botrylloides albicans*, *Morchellium argus*, *Morchellioides alderi*, n.sp., *Clavelina lepadiformis*, *Perophora listeri*, *Diplosoma crystallinum*, *Corella parallelogramma*, *Ascidia plebeia*, *Eugyra glutinans*, *Molgula occulta* and *Polycarpa monensis*, n.sp.

Other members of the Committee continued, during the summer, to make collections at Hilbre Island, and various points on the coast in the neighbourhood of Liverpool.

Early in October, a meeting of the Biology Committee was held at University College, when all the collections, which had been preserved and stored in the Zoological Laboratory, were inspected and roughly classified. The conclusion was unanimously arrived at, that so much new and interesting material had been brought together during the summer's work, that it was desirable that the collections should be worked up by specialists, and the results published before the next season's dredging investigations commenced. The various groups were then placed in the hands of the members of the Committee and other naturalists who had consented to take charge of them, and whose Reports compose this volume; and shortly afterwards, on October 19th, Professor Herdman, at the request of the Committee, laid

a preliminary Report upon the first year's work before the members of the Liverpool Literary and Philosophical Society.

A proposal was then made that the Council of that Society should undertake the publication of the series of Reports, as an Appendix to the annual volume of *Proceedings*, and also as a separate publication; being aided, if necessary, by grants from the other local scientific societies, and by private subscriptions.* This proposal was accepted, and the present volume is the result. All the chief groups of invertebrate animals which were collected have been reported upon, but a few of the smaller groups, such as the Rotifera, the Ostracoda, the Turbellaria, and some others, have not yet been overtaken. These, along with supplementary reports upon those larger groups which need them, and monographs upon special animals, and a report upon the fishes of the district which Mr. T. J. Moore has undertaken to draw up, will form the subject matter of a second, and possibly of several additional volumes, which will probably be published by the Committee after one or two years of dredging, and other investigations in the locality.

In order to render this Fauna of Liverpool Bay as nearly complete as possible, the species recorded by all previous investigators have been discussed along with those actually collected by the Committee. Consequently most of the Reports may be regarded as including records of all the work done upon the particular groups of animals in this District, brought up to date.

It only remains to record the numerical results of the first year's work of the Committee; for all further details the separate reports on the groups must be consulted. Prior

* A list of the subscriptions will be found on p. 371, at the end of this volume.

to 1853, investigators* in this locality, as recorded in Mr. Byerley's *Fauna,*† had discovered in all about 270 species of Marine Invertebrata. Since that date there has been no general work on the subject. The Liverpool Marine Biology Committee have to place on record altogether 913 species,‡ of which at least 235 had not been found before in the locality. Sixteen of these species have not been previously discovered in British seas, and at least seven species and three varieties are new to science.

UNIVERSITY COLLEGE, LIVERPOOL,
*January*, 1886.

* For full details in regard to the work of previous observers, see Mr. Higgins' Report, p. 16.

† Appendix to vol. viii of *Proc. Lit. and Phil. Soc. of Liverpool*, 1855.

‡ Including previous records. The district investigated by the L. M. B. C. is of somewhat wider extent than that treated of by Mr. Byerley.

## PIONEERS IN LOCAL BIOLOGY.

By Rev. H. H. Higgins, M.A.

The earlier workers in the field of our local Natural History, before the word Biology in its more restricted sense had come into use, or the special study for which the term now often stands was more than rarely and imperfectly appreciated, belonged to a class of observers capable of doing excellent service to the science of their own day. Take for example the aid rendered to Geology by conchological collectors. Not a few memories are warmly cherished in Liverpool, of fellow-townsmen devoted to the pursuit of natural science, whose contributions to the literature of the subject extended only to the occasional appearance of their names as donors of specimens to authorities such as Johnston, Jeffreys, Yarrell, Carpenter, Alder, Landsborough, and others.

But at the outset of a series of papers, the materials for which must to an important extent depend on the use of the marine dredge, Liverpool naturalists will be glad to be reminded that one of the first explorers of the sea-bottom for scientific purposes was a Liverpool merchant, Robert McAndrew, who, with his friend, Edward Forbes, have left undying names amongst the members and in the volumes of the British Association. Mr. McAndrew was a liberal contributor to the museums of Liverpool, and a generous promoter of every effort made to investigate the Natural History of the vicinity. His very fine collection of British and foreign Shells is now in the Museum of the University at Cambridge. It is remarkable for a large number of series illustrating the growth of shells from the nucleus, of micro-

scopic proportions, to the full-sized shell. A considerable number of the species were collected within the Liverpool Bay. Mr. McAndrew was President of the Liverpool Literary and Philosophical Society in 1855.

By far the best and most important memoir claiming to be here noticed, has been thus mentioned* :—

FAUNA OF LIVERPOOL, by ISAAC BYERLEY, F.L.S., M.R.C.S.E., Literary and Philosophical Society. Appendix to Proceedings, vol. viii., 1853–54, pp. 125.

Species, Mammalia 42, Aves 195, Reptilia 5, Amphibia 6, Pisces 100, Mollusca 181, Crustacea 70, Lepidoptera 714, Annelides 33, Acalephæ 12, Echinodermata 11, Hydrozoa 35, Anthozoa 6, Polyzoa 26, Spongia 5.

A valuable work, the best portions of which are those which were contributed mainly through Mr. Byerley's own investigations.

During the excursions of the L. M. B. C. in the summer and autumn of 1885, so small a number of vertebrate animals was collected that it was thought better to defer an account of previous work done in this department till the appearance of a second volume; more especially, since a very considerable amount of interesting materials might be collected from various sources. Long lists of Mammalia, Aves, and Pisces, are given by Mr. Byerley in his *Fauna*, often accompanied by valuable details, especially in the fishes. Our esteemed friend, Mr. T. J. Moore, Curator of the Public Museum, has given some short but valuable communications on our locally-collected vertebrate animals to the Literary and Philosophical Society. Most of these, but not all, have been noticed in the *Proceedings* of the Society. Occurrences of rare species are described in scattered records, which may possibly require careful weeding, as well as industrious finding.

* List of local papers on Nat. Hist., *L. N. F. C. Proceedings*, 1874.

Mr. Byerley's *Fauna* recorded the occurrence of more than one specimen of the bottle-headed Dolphin, *Hyperoödon*; also of the Dormouse and of the Marten.

The Mollusca of the district, land, fresh-water, and marine, are represented in Mr. Byerley's *Fauna* by a fine series of 181 species, of which 128 are marine; most of them, with many others, have been more recently taken within our area. The local workers in marine shells, most frequently quoted, are Dr. Donald Cameron, Mr. Webster of Upton Hall, Mr. F. P. Marrat, and for the shell-less marine species, Mr. John Price.

To the north of Anglesea, within our area, must be some dredging ground very prolific in the Mollusca; for about the time when Mr. Byerley's *Fauna* was printed, the writer spent three days on the sands and low rocks of Red-wharf Bay, eight miles from Beaumaris, and succeeded in collecting 84 species, an unusual number to be obtained without the use of boat or dredge.

Not long after, whilst the writer was collecting with Mr. Byerley, on Caldy Blacks, in the river Dee, one lovely midsummer's morning, betwen four and five a.m., the incoming tide, approaching from Daw-pool Deeps, cut us off, and though we rushed to our trap, and drove as rapidly as possible through the impatient stream, for a time it seemed more than likely that the horse would have to swim, and the trap be upset. I venture to recommend the members of the Marine Biology Committee, visiting Caldy Blacks during the low spring-tide of a June morning, to place a sentinel on the out-look, as a possible substitute for their own fascinated powers of attention to environments. The following species were found at Caldy Blacks: — *Venus fasciata*, a valve, *Trochus cinerarius*, *Chiton cinereus*, *Doris*, three species, *Eolis*, one species, and many Hydrozoa.

In the Crustacea, Byerley's list of 70 species includes

some which have very rarely been taken since; *e.g.*, *Nephrops norvegicus* and *Pasiphœa sivado*. The Entomostraca seem to have been chiefly collected by Mr. H. Weightman, who has recently occupied the chair of the Microscopical Society.

After enumerating 11 species of Echinodermata, Mr. Byerley next supplies a list of 85 Hydrozoa, in which for the first time prominently appears the aid of our veteran *collaborateur*, R. A. Tudor, of Bootle, who in earlier days was a valued correspondent of some of the most distinguished men in "Marine Biology," including Alder, Hancock, Landsborough, and Mr. Bean of Scarborough.

The writer has selected from the *Fauna* some remarks by Mr. Byerley, on *Actinia troglodites*, as illustrating the true spirit of a Biological Observer:—

*Actinia troglodites.*

Has been found in pretty good numbers upon the Leasowe shore and near Egremont slip. I have kept as many as eight or ten together for upwards of six weeks. They were very often ill-used for want of a fresh supply of sea water, but seemed to be most tolerant under the infliction. It was seldom until after having been kept for ten or twelve days in the same water that they began to droop considerably, and they were speedily restored by a change. No food was given at any time. At first they threw off a great number of germs or ova, which, before they were extruded, could be plainly seen through the external envelope, and especially at the bases of those specimens which had not attached themselves, and could be turned over for examination. It appeared quite clear to me that these germs, young actiniæ (or whatever they may be called), made their exit through breaches of continuity in the outer envelope, near its junction with the basal disk, and sometimes through ragged apertures in the base itself; in fact, I have hooked out the germs which were just on the point of emerging with a blunt probe, which was delicately used, and *did not make* the opening. The germs were about the size of a pin's head, and perfectly globular; they showed, by careful watching, a very sluggish motion. Three or four were put into a wide-necked 1½-oz. bottle, having a ground glass stopper, with sea water, and were intended for a microscopic inspection in the evening; they were quite forgotten

however, and at the expiration of two months one was found to have become developed into a perfect but very small actinia. It is now (after six months) alive, but has never increased in size; it continues closely shut up, when there is a fresh supply of water, for some days, but after a week, and from that to a fortnight, fully expands again. For this reason the water has not been changed more than six times since it has been in my possession. No pabulum of any kind has ever been given. It seems to make no difference whether the stopper is kept in the bottle or not, so far as the animal's health is concerned. These creatures were shy of expanding during the day, and then were as flat as a coin. I used always to pay them a visit before bedtime, knowing that I should be repaid by a view of their full-blown expansion during the previous darkness. The stimulus of candle light used to set their tentacula in active motion, without making them "retire for the night."

Mr. Byerley is still, and we trust may long continue to be, with us; more cannot, therefore, be said than that the author of the *Fauna* was more anxious for justice to be done to the labours of his friends than to his own; a proclivity which may account for the following sentence in the preface to the *Fauna* :—

"These remarks are made as an apology for any short-comings in this first attempt at a Fauna, the materials for which must always be receiving additions, and thus it never can be perfect. Much as I may feel on my own account, I must not dilate upon its imperfections, in justice to several industrious workers who have kindly assisted. Whilst dredging, the Rev. H. H. Higgins, Messrs. Webster, Samuel Archer, Marrat, and Cameron, afforded the greatest help; without their efforts much of the information relative to the creatures in the neighbouring waters could not have been obtained. The last-named gentleman undertook, single-handed, the not over agreeable or safe duty of dredging the Mersey."

That Mr. Byerley still continues to take a lively interest in our Local Marine Biology, is evident by a note the writer received from him, January 23rd, 1886 :—

"I should be very glad if you will keep a good look out for

*Noctiluca* when aggregated in patches. I saw one of these at Hilbre, where they had collected together in myriads, forming a circumscribed *red* patch about four or five feet in diameter. When I put my hand into it, it came out of the water completely covered with the little globules, all of a deep pink colour, so very different from the clear hyaline aspect of them as we usually find them Similar patches have been observed by Dr. Collingwood, and more recently; but the animals forming them were not examined. It is very desirable to know if this is a matter of not unusual occurrence, and what purpose it serves in the economy of the animal. In the Southampton water a Flagellate animalcule, *Peridinium fuscum*, I think, aggregates in the same way, but not in patches, as it is generally diffused, and continues to embrown the Southampton water from the end of July to September."

Amongst the sons of biological toil on the shores of the Mersey and the Dee no one has gained a wider reputation, or secured a larger amount of affectionate regard, than the writer's very old friend, John Price, M.A., St. John's, Cambridge, out of whose many eligible characteristics one alone shall here be noticed—his facility in finding stores of natural beauty and instruction in, apparently, the most barren scenes and objects. His "History of Birkenhead Shore" was published in ten or twelve numbers of *Old Price's Remains*, 1863-64. Only the Ctenophora can now be mentioned—*Beroë* and *Cydippe*, with which the name of Mr. Price will long be associated.

His first introduction to *Cydippe* occurred at the Woodside slip:—

"My eye fell upon a small object of transcendent brilliancy lying in a crevice on the wet stones just left bare by the ebbing tide. It looked like a pebble of the finest rock crytal, fashioned with consummate skill into the shape of a diminutive melon. After gazing on it in amazement, I took it up and found it was composed of a firm but tremulous jelly, about the size of a nutmeg, and exhibited on its eight ribs the most exquisite sculpturing I had ever seen, like the engravings of a signet. . . . Its perfect transparency was most remarkable. . . It was indeed 'a gem of purest ray serene.'"

"It is curious to think that these two gentle creatures, *Cydippe* and *Beroë*, which I encountered at such a long interval, and with which I became such good friends, proved to be mortal enemies! At least, that the *Beroë* should be the natural foe of the *Cydippe*, which she pursues and swallows, one after another (if small enough, to the number of three, four, or even five), till the ingerent and ingesta, both equally transparent, look like a gauze bag crammed with decanters! Whilst, if the victim be the larger of the two, as is very often the case, the captor will fasten on its prey like a lamprey, and take a large piece out of the side, leaving the poor unresisting *Cydippe* to sail about with cabin window wide open."

The paper on "Beroïd Babies" (*Remains*, p. 532), directs the willing observer to select, at the close of summer, "a large damaged specimen of *Beroë*" which he would reject for any other purpose, . . "and place it in a sample bottle of *very* clear sea-water; this will soon swarm with eggs." These, in his own metaphorical style, Mr. Price discourses on, especially noting that from the very first they are "so very like their own mama." Regarded as Hydrozoa, this might be noteworthy.

In the correspondence elicited by the preparation of the present paper, the writer received the following note:—

Jan. 23, 1886.

Dear Mr. Higgins,—I ought to have stated that *C. pileus* was *always* abundant at Birkenhead, *C. pomiformis* rare, *but perhaps often unnoticed*; *Beröe ovata* only occasional, sometimes tinted mauve, sometimes olive-grèen. *Alcinöe vermiformis* (Cuvier), which Patterson called *Bolina hibernica*, occurred twice only as *marvels!* I made fifty drawings of the first I saw! I met with several swimming past the little pier at Blairmore, on the north side of the Clyde, and caught one which *greatly* astonished Mr. Young, curator of the Glasgow Museum. It is a creature of *extraordinary* beauty, and *very* curious structure: "*vermiformis*" is a bad name, referring only to some *very* small *wriggling* tentacles, at the edge of the mouth. Look for him at the obsolete Monks' Ferry slip, south side, at half-flood or ebb. "Nature is true to herself," said Ed. Forbes, and there the creature came, *twice*, at *any*

rate. The same is a good station for *Cydippe*, and *Beroë*, and *Medusa;* and the shore and walls are *most productive*, in great variety. A *large shabby*-looking *Cydippe* is very apt to be "in spawn," and the ova will *float*, visible to the naked eye, and may be mistaken for *Noctiluca* (see *Remains*, "Beroïd Babies.") A *rushlight* shews such objects extremely well.—Our kind regards to all. Yours truly, J. PRICE.

These lines will elicit heartfelt admiration and sympathy in all who know the painful circumstances under which they were written.

Mr. Price regards *Cydippe* as the most beautiful of all invertebrate living things. When *Cydippe* is seen in perfection, the writer is quite inclined to agree with the estimate of Mr. Price, who adds:—

I never *saw Beroë* take any food but *Cydippes*, nor *Cydippe* any but a very ghost-like Shrimp with staring eyes (*Mysis ?*), refusing other Crustacea. Two *large Cydippes* were dissolved away in four and a quarter hours, and then replaced by two others. *Cydippes* may be often taken with the vessels full of a milky fluid. which shews the further process of digestion admirably. The *Beroë* is too flimsy to shew this so well. The trains and cilia work briskly after being swallowed. Query—How can the *Beroë* bite a hole out of the *Cydippe* when too large to bolt?—See *Remains*.

THE LIVERPOOL NATURALISTS' SCRAP BOOK.—Issued in the form of a pamphlet, with lithographic text. Sixteen monthly numbers appeared, commencing March, 1863. A copy may be consulted in the Free Public Library. A few brief extracts only can here be given:—

1. Are Shrimps nocturnal?

Their habits, as observed in aquaria, indicate that Shrimps are noctural, but Prawns diurnal animals (p. 4). Thomas J. Moore.

2. Reasons for including Flintshire in the Liverpool district. F. Archer, p. 32.

3. Hidden marine shells and the tracks they make. F. P. Marrat, p. 126.

4. *Syrinx harveii*, two or three specimens. Long and interesting

morphological and anatomical details, p. 142. Charles H. Brown, Southport. Locality, where *S. harveii* was taken, not certain.

5. Entomostracon. New to the district; described and figured by T. J. Moore, p. 216.

6. Annelid. New to the district; described and figured by T. J. Moore.

7. Alga. *Delesseria sanguinea.* Near the Alt. C. S. Gregson.

Thomas J. Moore.

*Sepiola atlantica*, Formby.
*Clava multicornis*, Dingle.
*Eledone cirrhosus*, Mersey, with very interesting and full details.
*Portunus arcuatus.* On the bar.
*Mysis Chamæleon*, Bootle.
*Corystes cassivelaunus.*

F. P. Marrat.

Marine Algae, 19. 44. 21. 10. 5. Total 99.

Mr. Marrat's Algae were found in the restricted district, and were carefully identified.

Comparatively small space is given in the Liverpool Naturalists' Scrap Book to Marine Biology. Other kindred subjects occupy five-sixths of the volume.

On June 22nd, 1865, during an expedition of the Liverpool Naturalists' Field Club in the steamer "Eblana," Mr. F. P. Marrat collected the following species of Algæ on the shores of Puffin Island, at the entrance to the Menai Straits. The names are taken from Harvey's *Phycologia Britannica*:—

*Phyllophora rubens*
*Halidrys siliquosa*
*Corallina officinalis*
*Jania rubens*
*Enteromorpha ramulosa*
*Enteromorpha intestinalis*
*Enteromorpha compressa*
*Hydnea purpurascens*
*Gelidium corneum*
*Ceramium deslongchampsii*
*Ceramium rubrum*
*Rhizoclonium riparium*
*Delesseria sanguinea*, very rare and bad
*Delesseria sinuosa*
*Delesseria alata*
*Rhodymenia ciliata*
*Dumontia filiformis*
*Cladophora flexuosa*
*Phyllophora membranifolia*
*Cladostephus spongiosus*
*Cladostephus verticillatus*
*Porphyra vulgaris*
*Cladophora diffusa*

*Ptilota sericea*
*Ptilota plumosa*
*Ulva linea*
*Griffithsia setacea*
*Griffithsia equisetifolia*
*Iridæa edulis*, a torn specimen
*Sphacelaria plumosa*, rare
*Sphacelaria scoparia*
*Sphacelaria cirrhosa*
*Sphacelaria fusca*
*Cladophora lætevirens*
*Cladophora rupestris*
*Cladophora rudolphiana*
*Bryopsis plumosa*
*Asperococcus echinatus*
*Chordaria flagelliformis*
*Desmarestia aculeata*
*Gracilaria confervoides*
*Rhodomela subfusca*
*Melobesia fasciculata*
*Chondrus crispus*

To Cuthbert Collingwood, M.A., M.B., author of *Rambles of a Naturalist on the Shores of the China Sea*, Hon. Sec. of the Liverpool Literary and Philosophical Soc., 1860–65, must be assigned a distinguished place amongst the pioneers of our local Natural History; and though his writings, attractive in style as they are, indicate a compiler and a chronicler rather than an investigator, he was a zealous worker as well as a wide and an appreciative observer.

In two papers published in the *Proceedings* of this Society, 1863–4, on the Geological Fauna and the Historic Fauna of the District, Dr. Collingwood has quoted a very large number of authorities, principally on the fossil remains or recent occurrences of vertebrate animals.

In June, 1859, September, 1860, and January, 1861, Dr. Collingwood published in the *Annals and Magazine of Natural History*, three papers on the Nudibranchiate Mollusca of the Mersey and the Dee, from which the following list is taken:—

List of the Nudibranchiata of the Mersey and the Dee.

1. *Doris tuberculata.* Mersey and Dee; common.
2. —— *johnstoni.* Mersey and Dee; once or twice.
3. —— *proxima.* Mersey and Dee; common (found nowhere else).
4. —— *bilamellata.* Mersey and Dee; abundant.
5. —— *pilosa*, Mersey and Dee; not uncommon.

6. *Doris subquadrata.* Dee; once (the second known specimen).
7. —— *depressa.* Dee; once.
8. *Polycera lessonii.* Between Mersey and Dee; once.
9. —— *ocellata.* Mersey and Dee; occasional.
10. *Ancula cristata.* Mersey and Dee; common.
11. *Tritonia hombergii.* Mersey and Dee; occasional.
12. —— *plebeia.* Mersey and Dee; occasional.
13. *Dendronotus arborescens.* Mersey and Dee; common
14. *Doto coronata.* Mersey and Dee; very common
15. *Eolis papillosa.* Mersey and Dee; common.
16. —— *coronata.* Mersey and Dee; common.
17. —— *drummondi.* Mersey and Dee; very common.
18. —— *rufibranchialis.* Mersey and Dee; not uncommon.
19. —— *landsburgii.* Mersey and Dee; rare.
20. —— *concinna.* Mersey; common (the second known locality).
21. —— *olivacea.* Dee: once taken.
22. —— *aurantiaca.* Mersey and Dee; common.
23. —— *picta.* Mersey and Dee; not uncommon.
24. —— *exigua.* Mersey; apparently rare.
25. —— *despecta.* Mersey; common.
26. *Embletonia pallida.* Mersey (the only known locality): very rare.
27. *Antiopa cristata.* Dee; occasional.
28. *Antiopa hyalina.* Dee (the only known locality); very rare.

All these papers are excellent, but, in the *Annals*, they are so thoroughly within easy reach of students that any lengthened reference to them would be needless in the present paper. But let those who feel inclined to study this beautiful group by all means read these three papers in the *Annals*. It is truly refreshing to find objects of natural beauty exciting a freshness of enthusiasm that is easily lost but impossible to be recovered.

About the same time, 1859, John Baker Edwards, Ph.D., F.C.S., read a paper before the Literary and Philosophical Society, on "The Marine Animals of the Mersey Shore," with especial reference to the management of marine aquaria for the study of the habits, life-histories, and physiology of

our local species. Dr. Baker Edwards was a very energetic and successful worker in aquaria, thus becoming a pioneer in an advanced department of our local Biology.

The Liverpool Naturalists' Field Club, since its establishment in 1860, has held many expeditions for dredging, and excursions to various parts of the coast. At the close of each year, prizes in the form of books on Natural Science are given to the most successful collectors. Two prizes have been gained in Algæ, two in marine shells, and two in Hydrozoa and Polyzoa. In the latter classes, the collection made by Mr. and Mrs. Howard Chapman, wholly from specimens found on the shore, was remarkably good, and contained many rare forms.

The Chester Society of Natural Science has published its *Proceedings* in three parts, well worthy of the scientific work they represent, which does honour to the distinguished founder of the Society, Charles Kingsley, Canon of Westminster.

Dr. Henry Stolterfoth, M.A., in *Proc. C.S.N.S.*, Part 2, 1874, gives a List of Diatomaceae found in Chester and the district, and Cwm Bychan, N.W. Very many of the species were collected in the estuary of the Dee. The list is copious, and occupies twelve pages. Fifty-eight genera are included, of which *Navicula* alone is represented by eighty species. The same author contributes to Part 3, a paper on "Surface dredging on the Dee." The paper describes many special forms of microscopic life found on the surface of the estuary of the Dee, with the author's method of collecting them.

Mr. J. D. Siddall has contributed to Part 2 an excellent paper on the Foraminifera of the River Dee. About 134 species are recorded, and Mr. Siddall makes some valuable observations upon the living Foraminifera.*

* See Mr. Siddall's "Report upon the Foraminifera of the L. M. B. C. District," p. 44.—Ed.

Mr. A. O. Walker, F. L. S., although one of the most thorough-going of our local Pioneers in Marine Biology, has given his name less frequently than his valuable assistance. In the opening pages of Part 2, *P.C.S.N.S.*, occurs a short paper of his, entitled, "Observations on Phenomena connected with the deposition of Sediment at the present day in the estuary of the Dee, and their bearing upon older deposits." It is a short paper, but leads to results higher than even the finding of rare or undescribed species. Very little has been done locally in the philosophy of life at the bottom of the sea.

FREE PUBLIC MUSEUM OF LIVERPOOL.

The specimens now exhibited in the table cases as British representatives in the six groups assigned to Sertularian and allied Zoophytes, and to the Polyzoa, were, with few exceptions, collected on the shores of the Mersey and the Dee, by the Rev. Henry H. Higgins, and were by him presented to the Museum, together with many of the exhibited British representatives of the Marine Mollusca.

LIVERPOOL NATURALISTS' JOURNAL.—Published in connection with the Liverpool Naturalists' Field Club. Printed in monthly numbers, of which 20 appeared, commencing June, 1866.

It was designed to be "an organ by means of which naturalists might record their observations and communicate their ideas for their common benefit."

The Journal contains about 120 communications, which, though not confined to local natural history, include much information on the subject. Amongst the contributions of a more general character may be mentioned a valuable series of papers on the "Development of Plants," by J. B. NEVINS, M.D., and various articles by F. ARCHER, Jun. A copy may be consulted in the Free Public Library of Liverpool.*

* List of local papers on Nat. Hist., *L.N.F.C.*, H.H.H., 1874.

No. 5, p. 77. I. Byerley. Spontaneous fission in *Anthea cereus* and *Sagartia candida.* The latter into four fragments. The writer noticed indications of a similar action in a stony coral, *Halomitra,* but is unable to recover the paper in which the phenomenon is described.

No. 14, p. 155. I. Byerley. Tenacity of life in the cilia of a mussel, and in a *Littorina.*

T. J. Moore. Cuttle-fish, *Sepia officinalis,* from Burbo Bank.

No. 16, p. 174. W. Banister. Habit in *Dianthus plumosa,* of throwing off mucus when irritated.

The communications made to the *Liverpool Naturalists' Journal* were almost entirely botanical.

### Transactions of the Historic Society of Lancashire and Cheshire.

A considerable number of papers on local Zoology and Botany may be found scattered in these Transactions; very few, however, relate to the special subject of the Report.

Thomas Comber. *Trans.,* vol. xi, 1859.

"List of Diatomaceae found in the vicinity of Liverpool." Mr. Comber offered this paper as a contribution to the Flora of Liverpool, already fairly represented in most of the other groups. The list contains 257 species, included in fifty-one genera, and has been named and arranged after W. Smith. Mr. Comber mentions as his fellow-workers, G. Mansfield Browne, T. Sansom, and L. Hardman.

Richard A. Tudor. *Trans.,* vol. viii, 1856.

"General Remarks on the Natural History of the Shores of the Mersey." Mr. Tudor's name occurs in the *Annals,* and in the volumes of the Ray Society as a correspondent and fellow-worker with the distinguished authors of Monographs, but his published remains are so uncommon that the

writer was gratified in finding some short extracts from the above-named paper.

"In many patches, nearer to high water mark, on the shore, may be observed millions of worm casts. These are produced by the lob or lug-worm. A few inches from the cast may invariably be seen a round hole, through which the animal came and fed while the tide covered the surface; and the cast is deposited after the nutritious portions have been extracted. These creatures are very much sought for by fishermen, and when first taken, they display the prismatic colours very beautifully by their movements. The rings of the head of this animal are very peculiarly constructed, forming a regular cone, which it has the power of drawing in and extending as circumstances require. In these localities the ripple marks, formed by the recent action of the water, present very beautiful appearances, and the shade produced by the varying altitude of the sun cannot but attract the attention of the observer. They partake of great similarity in shape and character."

On February 3rd, 1886, the writer received a note from Mr. R. A. Tudor, who speaks of having collected on the shores of the Mersey, with Mr. Johnson, Curator of the Royal Institution; and in the Isle of Man, with Professor Edward Forbes. Mr. Tudor has now entered his 89th year.

The following table is a Report* drawn up by Mr. Byerley and Dr. Collingwood, in behalf of a Dredging Committee of the Estuary of the Mersey, appointed by the British Association, at the Oxford Meeting, 1860.

NAMES OF COMMITTEE.

| | |
|---|---|
| Dr. J. Gwyn Jeffreys. | Isaac Byerley. |
| Dr. C. Collingwood. | Dr. J. B. Edwards. |
| Rev. H. H. Higgins. | Thos. J. Moore. |

The writer's desire to collect together as many as possible of his old Natural History friends, some of them very old friends, yet all, with two exceptions, still living, arose from his recognising the issue of the present volume as epoch-making in the study of the Fauna of the Liverpool Bay.

* From *Brit. Assoc. Report* for 1861.

| | Mersey and Dee, &c. | Proportion, about | British. | Characteristic or dominant species. | Rare and remarkable species. |
|---|---|---|---|---|---|
| | Species. | | Species. | | |
| MARINE FISH ........ | 79 | 1/4 | 316 | Lesser Weever, Unctuous Sucker, Armed Bullhead, Sand Lance, Spotted Dog-fish, &c. | Sturgeon, Angler, Lump-sucker, Gemmeous Dragonet. Opah, A Torpedo, A A |
| CEPHALOPODS ...... | 6 | 1/2 | 13 | Sepiola atlantica ................ | Oct |
| GASTEROPODS :— | | | | | |
| Prosobranchiata.. | 81 | 1/7 | 219 | Littorina littorea, Rissoa ulvæ, Purpura lapillus, Buccinum undatum. | Rissoa vitrea, Lacuna crassior, L. vincta. |
| Opisthobranchiata | 5 | 1/5 | 24 | Cylichna obtusa | Bullæa |
| NUDIBRANCHIATA .... | 28 | 2/7 | 100 | Doris bilamellata, D. proxima, Dendronotus arborescens. | Antiopa pallida, Doris ...concinna. |
| LAMELLIBRANCHIATA.. | 46 | 1/4 | 166 | Mytilus edulis, Cardium edule, Tellina solidula, Mya truncata, Pholas crispata, P. candida. | Montacuta, Artemis, Venus ovata, Crenella marmorata. |
| TUNICATA .......... | 4 | 1/19 | 75 | | |
| CRUSTACEA :— | | | | | |
| Brachyura ...... | 10 | 1/4 | 41 | Portunus depurator. Carcinus mænas. | Gonoplax angulata. Corystes Cassivelaunus. |
| Anomoura ...... | 4 | 1/5 | 20 | Pagurus, Porcellana longicornis. | Galathea Andrewsii. |
| Macrura ....... | 7 | 1/7 | 46 | Pandalus annulicornis, Crangon vulgaris. | Pasiphæa sivado. |
| Amphipoda ..... Stomapoda .... Isopoda........ | But few. | | | | |
| ENTOMOSTRACA ...... | 9 | | | | |
| ANNELIDA .......... | About 18 genera. | | .......... | Amphitrite ventilabrum. | |
| ECHINODERMATA .... | 11 | ............ | .......... | Uraster rubens, Ophiocoma rosula.. | Cucumaria communis. |
| POLYZOA............ | 21 | 1/6 | .. ....... | Gemellaria loricata, Alcyonidium galatinosum. | |
| HYDROZOA :— | | | | | |
| Corynidæ. ....... | 7 | ............ | .......... | | |
| Sertulariadæ .. | 19 | 1/2 | 44 | | eta. |
| Campanulariadæ | 7 | 1/4 | 28 | | |
| Acalephæ........ | ............ | ............ | .......... | | |
| ACTINOZOA.......... | .. ......... | ............ | .......... | | anthemum. |
| SPONGES .......... | Few. | ............ | .......... | | |

# On SHALLOW WATER FAUNAS.

By A. Milnes Marshall, M.A., M.D., D.Sc., F.R.S.,
BEYER PROFESSOR OF ZOOLOGY IN OWENS COLLEGE.

Animals may be classed according to their habitat as terrestrial or aquatic, and the latter subdivided into fresh water forms and marine forms. The marine fauna, again, falls very naturally into three main groups,—the shallow water and shore animals, the deep-sea animals, and the pelagic or oceanic animals.

The entire animal kingdom may thus be divided into five groups; and, although it is impossible to separate these by sharp boundary lines, and an animal may in the early stages of its existence belong to one group, and when adult to another, yet the division is very generally accepted as a real and natural one, and it is both possible and profitable to enquire into the general characters of the several groups, and to attempt to determine their mutual relations.

I have chosen shallow water animals as the subject of the present paper, because it is with these that the Liverpool Marine Biology Committee will be chiefly concerned; and I propose to confine myself to the general characters of the shallow water fauna, and its relations to the other great groups. The application of these general principles to the special features of the area with which the Committee is occupied will, I think, be wisely postponed until further knowledge and experience of its fauna have been acquired.

The materials for the preparation of this paper are mainly derived from the reports of the various dredging and exploring expeditions which have been sent out by our own and other governments during the last twenty years. To the writings

of Professors Moseley and Semper I am under very special obligation.

The shallow water fauna is found in the greatest profusion, and in its most characteristic form, between tide marks, and at depths extending from low water level down to about fifty fathoms. From fifty to two hundred fathoms it occurs in less typical condition, and below the latter depth passes gradually into the deep sea fauna.

The most marked features of this shallow water fauna are the great profusion and variety of forms which it presents. Representatives of nearly every one of the great groups of animals occur, and the actual number of species very greatly exceeds that of the other ocean faunas.

As regards environment, the chief point is its extreme variability, which stands in the most marked contrast with the almost absolute uniformity of external conditions affecting the deep sea fauna. Thus, animals living between tide marks are exposed daily, and may spend half their lives in and half out of water, while both they and animals living at rather greater depths are subject to changes of enormous violence at times of storms. Again, shallow water animals, especially those that are periodically exposed, are liable to considerable variations of heat and cold, and of light and darkness.

The varying nature of the sea-bottom, whether rock, sand or mud; the proximity of great rivers, or other causes that may modify the quality of the water; and the various changes effected round the coasts by human agency, all help to swell the list of causes that render the environment of shallow water animals singularly inconstant. Another special feature is the abundance and variety of plant life, affording a copious supply of food denied to the inhabitants of deeper waters. The actual bathymetrical distribution of plants is less accurately known than that of animals, but the ordinary seaweeds do not extend below fifty fathoms, while below

two hundred fathoms vegetable life almost completely disappears.

This extraordinary variability in the external conditions of life is undoubtedly the great cause of the extreme diversity shown by the fauna exposed to it, and is perhaps best realised by comparing it for a moment with the environment of the deep sea fauna. Here we have animals living for the most part in absolute darkness, in water that is never more than a few degrees above the freezing point, on a sea bottom that is perfectly uniform over areas of very great extent, and largely dependent for food on other animals which, having died at or near the surface, have slowly sunk to the depths below.

Turning now to the special characters of the shallow water animals themselves, perhaps the most general feature they present is the power of fixing themselves in, or to, the sea bottom in order to resist the tides and storms, which would otherwise destroy them, or carry them out to sea.

This fixation is brought about in very various ways. It may be either a temporary one, such as is effected by the muscular foot of a limpet or chiton, or by the base of a sea-anemone; or a permanent one, as in barnacles, oysters, ascidians, etc., where the animal is immoveably attached to rock or other firm support.

In other cases, the requisite anchorage is obtained by burrowing in the sand or mud of the shore or sea bottom. These burrows may be simple holes, such as those made by many bivalves, or may be lined by tubes secreted by the animal. Similar tubes may be formed for protection by animals that do not burrow, and are then attached to foreign bodies, either by their basal ends, as in many hydroid zoophytes and worms, or along their entire length, as in *Serpula*.

It is a very noteworthy fact that, in all cases in which the

adult is attached, and these include a large proportion of the shallow-water fauna, the animal in the early stages of its existence leads a free swimming life, and is often entirely unlike the parent in appearance and structure. This fact, which will be referred to again further on, is to be regarded as evidence of the strongest kind that the attached condition is a secondary one, acquired in accordance with the habitat of the animal; in other words, that the attached forms are descended from free-swimming ancestors.

A large number of these attached forms, especially in the more lowly organised groups, e.g., Sponges and Cœlenterates, have the power of reproducing asexually, as well as by means of eggs, the asexual process being usually one of budding. A bud is commonly a hollow process of the body wall of the parent, which gradually increases in size and complexity until it becomes a second animal in all respects like its parent. It may then either separate and become a distinct animal, or, as is more usually the case, may remain permanently attached to, and in communication with the parent. Both the bud and the parent may give rise to fresh buds, and in this way a "colony" is formed, this being the name given to such an aggregation of individuals formed by budding, and remaining organically connected together.

Such colonies are not confined to the shallow-water fauna, but are far more abundant and more varied there than in either the deep sea or the open ocean, and hence may be very suitably considered in this place.

From their mode of formation, described above, it follows that the several members of a colony are fundamentally equivalent to one another. In the simpler forms they remain all alike, and, although organically connected with one another, still practically independent. Examples of such colonies are presented by many of the Polyzoa,

which form flattened leaf-like colonies, either growing independently, or encrusting the surface of rocks or seaweed. In Sponges, the connection between the several individuals of a colony is a more intimate one, and it is usually impossible to determine the boundaries of the several component members, which are blended indistinguishably with one another, and traversed by a common canal system serving for the nutrition of all alike.

In other cases, as in the hydroid zoophytes, and to a less extent in the sea-pens and other corals, the several members of the colony, though retaining their essential similarity, become modified in various ways so as to better adapt them to fulfil some one or more functions. As this can only be done at the expense of other functions, a certain amount of mutual dependence is at once set up; and, in many instances, this differentiation is carried so far that certain individuals of the colony are alone able to digest food, which they do for themselves and for all the others as well. Of these latter, some members are specially modified for capturing prey, others are either actively or passively protective in function, while to others is assigned the formation and ripening of the eggs.

The structural differences between the several members of such a colony are as marked as the functional, and it is often only by tracing their development that their essential identity can be established. The egg-bearing members of the hydroid colony usually take the form of jelly-fish or medusæ, which not unfrequently separate from the colony when ripe, and lead a free swimming existence for a time.

Of the shallow water fish, many, as the pilchards, whitebait, etc., go about in large shoals; but perhaps the most interesting are the Pleuronectidæ, or flat-fish, such as the turbot, plaice, sole, etc. In these, the body is very much compressed laterally, and the two sides are differently

coloured, one being white and the other variously tinted, according to the nature of the sea bottom. The fish when at rest lies on the white side, which in most flat fish is the left, and so exposes the coloured side only. By flapping movements of the fins it is able to bury itself more or less completely in the sand of the sea bottom, and further protection is afforded by the colour of the exposed surface changing until it resembles very closely that of the bottom on which it is resting. This power of changing colour depends on varying degrees of contraction and dilatation of certain pigmented cells in the skin—the chromatophores. It appears to be an entirely involuntary action, and does not occur in animals that are blind.

The same power is exercised in a still more marked degree, and here apparently voluntarily, by the Octopus, a shallow water animal, living in holes in rocks, and able by its great strength and the powerful suckers with which its arms are provided to successfully resist the tidal action of the waves.

Returning to the flat-fish, the most curious feature in their organisation is the fact that, in accordance with their habit of lying on one side, both eyes are situated on one side—the coloured one—of the head. When quite young a sole swims vertically with its back up, and has its eyes one on each side of the head. Very soon it acquires the habit of swimming and lying on its left side, and in accordance with this the head becomes twisted so that the left eye is brought over to the right side, and both eyes can be used when the animal is lying at rest at the bottom.

There can be no doubt that flat-fish are descended from more ordinarily constituted fish with their eyes one on each side of the head, and in the above history we have an excellent illustration of the Recapitulation Theory, which explains the early developmental stages and metamorphoses

of animals as due to a tendency to recapitulate in their individual development the characters of their ancestors.

Turning now to the relations of the shallow water fauna to the other faunas, we find that, though animal life is present on the bottom of the ocean at all depths, yet that it is not nearly so abundant at extreme as at moderate depths.

Concerning the deep-sea animals, we find the fauna is a very miscellaneous collection, including representatives of all the main groups of animals. We find further, that although some of the deep sea forms, notably the curious group of Holothurians known as Elasipoda, are more primitive than their shallow water allies, yet that this is not true of the deep sea fauna as a whole. Indeed, of the more archaic or primitive forms in existence at the present day, some, as *Limulus*, *Amphioxus*, the Ganoids, and the Dipnoi, are either shallow water or fresh water forms; while those that do occur in deep water, such as Pentacrinoids and Brachiopoda, are found in shallow water as well.

The general conclusion, then, to which we are led is that the deep sea fauna is not, as was once supposed, an essentially primitive one; that there is no evidence of the shallow water fauna having been derived from it; but that, on the other hand, the actual facts are much better explained by supposing the deep sea fauna to consist of forms that have been driven down from shallow water, by the struggle for existence, to regions where opportunities for bettering themselves are indeed not so great, but where competition is less keen.

A final argument may be derived from the supply of food. The deep sea has no ultimate supply of food in itself, for, as we have seen, plant life is unknown in it. Hence it is impossible that a deep sea fauna should have existed before a pelagic, or else a shallow water, fauna and flora had become well established.

The relation of the shallow water to the terrestrial fauna is an interesting one, but cannot be considered here in detail. It appears to have been of a give and take nature, for while on the one hand certain marine animals, such as crabs, have left the sea and become adapted more or less completely to a terrestrial habitat; on the other, *Onchidium*, a slug found on the shores of the Pacific and Indian oceans, and which by its whole organisation shows its descent from land slugs, is certainly no solitary example of a terrestrial form that has become more or less completely marine.

The mutual relations of the shallow water and fresh water faunas are of much greater importance. Geologically considered, the land is far less constant than the sea, and there are probably few spots on the earth that cannot be proved to have been under water at least once. It hence follows that the terrestrial and fresh water faunas are most probably derived from the more constant marine fauna, and in most cases presumably from the shallow water fauna, as being that immediately adjacent to the land.

In the case of the fresh water hydroid, *Cordylophora*, this migration from a marine habitat can actually be traced historically, and in the case of those fish, as the salmon and lamprey, which are partly marine and partly fresh water, such a derivation may be regarded as proved.

The general characters of the fresh water fauna entirely bear out this view. Of the great groups of animals the Echinoderms are absolutely unrepresented, and the Sponges and Cœlenterates have not half-a-dozen fresh water genera between them. The other large groups are all present, but many important divisions of them, as the Cephalopoda and Tunicata, are completely absent. Here, very much as in the case of the deep sea fauna, certain members of most of the groups seem to have worked their way from the sea up the rivers, the determining causes being the same in the

two cases, *i.e.* the possibility of obtaining new supplies of food, and of escape from enemies.

One of the most characteristic features of fresh water forms, as compared with their marine allies, is the large size of the eggs of the former. Thus, a crayfish, though but a third of the length of a lobster, has actually larger eggs. The explanation of this is probably to be found, as Professor Sollas has suggested, in the following considerations.

The effect of increased size of the egg is that the young, having a larger supply of food in the egg itself, hatch of larger size and greater perfection of development than would be possible were the egg smaller. Hence, in forms with large eggs, the earlier larval stages will be passed in the egg before hatching. This is of special advantage in the case of fresh water forms, firstly, because larval forms of very small size would be unable to withstand the currents in the streams and rivers in which they dwell, and so would be carried down slowly but surely to the sea; and secondly, because these earlier larval forms representing stages prior to the acquisition of a fresh water habitat, would not be suited to it, and might very conceivably be unable to live in it.

These considerations offer a ready explanation of such points as the passing of the early stages of development in the gills of the mother in the case of the fresh-water Anodon, and the subsequent attachment of the glochidia larvæ to fish, until they have attained sufficient size and strength to withstand the currents of the streams they inhabit.

Finally, the relation of the shallow water to the pelagic or oceanic fauna remains to be considered, and on this point it is very difficult to speak with certainty.

On the one hand, we find that in the pelagic fauna a comparatively small number of groups are represented. Sponges and Echinoderms are absent; there are but few pelagic worms, and of Arthropods, Molluscs and Vertebrates, only

certain groups have pelagic members. These facts, taken in conjunction with the further fact that pelagic animals are, as a rule, highly modified in accordance with their habits, point strongly to the pelagic fauna being a derived, and not a primitive, one; and if this be true, they must be derived from the shallow water fauna, which would thus become the most primitive of the faunas, and the parent of all the others.

On the other hand, we have the fact, already alluded to, that the larvæ and young of almost all marine animals are free swimming, and if these represent ancestral forms, as by the Recapitulation Theory we are compelled to suppose they do, then we must conclude that the ancestors of all marine animals were free swimming, presumably pelagic forms. It seems scarcely possible to regard these larval forms as secondarily acquired, and hence the conclusion to which we are led is that, while existing pelagic animals have probably with few exceptions acquired pelagic habits secondarily, yet that the most primitive animals were primarily pelagic, and that from them have sprung the shallow water fauna, from which in turn the others have been derived later on.

# REPORT upon the FORAMINIFERA of the L. M. B. C. DISTRICT.*

BY JOHN D. SIDDALL, *Chester.*

FOR the preparation of the following Report very little *new* material has been examined; but a careful revision has been made of work done previously, more particularly that for the compilation of a list of the Foraminifera of the River Dee.† This river is included within the district, therefore the forms found there are also included in the list given below. With his usual great kindness, Mr. H. B. Brady revised the Dee list, and carefully examined the whole of the examples referred to therein. As might be expected, the naming of a large series of organisms obtained in brackish-water, but whose natural habitat is the sea, was a matter of very considerable difficulty. Under such altered conditions the various forms do not always attain to their full development, either in size, or substance, or characteristic form. Further, also, the examination of the River Dee was most carefully and thoroughly done. Several years were given to the work, and consequently single examples of many interesting species were found. Several of these were new to British seas; a few had only been known previously as fossil forms—one was altogether new to science. Some few were so much modified in form that their nomenclature was a matter of considerable uncertainty. In such cases, the name given could, of course, only be considered as possibly right, but not beyond doubt. I have, therefore, very carefully re-examined the examples then obtained, and have compared them with the figures

* The limits of this district are—first, a line from the Isle of Man to the opposite coast of Lancashire; second, a line from the Isle of Man to Holyhead (see Chart, Pl. XI).

† Proceedings Chester Society of Nat. Science, part II, 1878, Chester.

and descriptions given in Mr. Brady's splendid monograph on the Foraminifera collected during the cruise of H.M.S. "Challenger." The thorough and comprehensive character of this publication will render comparatively easy all future work upon Foraminifera. From the knowledge gained by the examination of such large series of examples, Mr. Brady has re-classified and arranged the Foraminifera, and has considerably modified their nomenclature. I have not hesitated to adopt fully all these changes. This will account, in part, for the differences between the list above referred to and that appended below. The same fact must also be borne in mind when comparing the lists of forms occurring in Dublin Bay and not in Liverpool Bay, and *vice versâ*, some few of them being mere differences of name, Messrs. Balkwill and Wright's list of "Recent Dublin Bay Foraminifera,"* having been published just prior to the "Challenger" volumes.

Material for examination has been obtained chiefly by scraping the sand or mud in the most promising-looking places between high and low water marks. The most prolific gatherings have been obtained at the following points :—

A sandbank opposite the old Cheesestage at Chester.

A sandbank opposite the wharf at Saltney.

A sandbank opposite Connah's Quay.

Tide pools on muddy shore at Holywell.

Between the rocks at Hilbre Island.

The shore, Isle of Man.

Stony shore, laminarian zone, Llandulas Point.

Muddy and stony shore, laminarian zone, Colwyn Bay, near Little Ormes Head.

Under the pier, Llandudno.

The Conway shore of Great Ormes Head.

* Vide *The Transactions of the Royal Irish Academy*, vol. xxviii, March, 1885.

The material from the above localities has been collected and dried as usual, and the shells separated in the main by the process of "floating;" but several of the rarer species have been obtained by the re-examination of such material as refused to float at all.

Dredgings have also been made at various points in the River Dee; off Rhyl; in Colwyn and Llandudno Bays, and the Menai Straits; and the material examined as usual; but not one example has been obtained in this manner which has not also been found in shore gatherings. I do not mean to infer by this statement that dredging is not likely to add to the list; on the contrary, I think it is from such sources that any additions of importance are likely to accrue. A glance at the comparative lists of Dublin Bay, the material for which was obtained *chiefly* by dredging, and Liverpool Bay will be instructive in this respect.

Surface dredgings have yielded absolutely nothing. The estuary of the Dee teems at times with Diatoms and other floating microzoa, and the tow net on such occasions, is soon thickly coated with them. It is the same off Rhyl, Colwyn and Llandudno; but Foraminifera are conspicuous by their absence. The experience of collectors in other seas proves beyond doubt that certain species of Foraminifera are almost exclusively pelagic when living; but such is not the case with our comparatively shallow water British forms. I have obtained alive, and kept in bottles, and repeatedly examined specimens of most of the types of Foraminifera enumerated in the following list; but these have invariably been got from the mud at the bottom of shore pools of greater or less depth. Under the influence of the sunlight, the Diatoms and other Algæ which grow in the mud at the bottom of such pools, often rise to the surface in patches. These act as rafts, and carry the Rhizopoda up with them. Once up, the outspread pseudopodia enable even the largest and heaviest forms we

get in our district to float perfectly. I have seen a shore pool at Holywell covered quite thickly with *Polystomella striato-punctata* (the commonest form in the Dee), its reddish coloured sarcode rendering it easy to distinguish on the surface of the water.

So little is even yet known of the life history of the Rhizopoda, that it seems of some importance to know where and how to obtain living specimens for study, and how best to separate and keep them. They may always be got by carefully scraping the surface of the velvety brownish mud at the bottom of pools left by the tide; or by skimming the top of the water, if this mud be found to have risen under the influence of sunlight. The oozy mud may be got rid of by washing through a fine muslin net, and the residuum put into small bottles filled with sea water. The bottle should be kept uncorked in a cool place, out of direct sunlight, when the Foraminifera will creep up the bottle sides, and live there for months. They are readily transferred by means of a fine pointed camel hair pencil to a slide or cell for microscopical examination.

The great abundance of the dead shells of Foraminifera in and upon the sand banks of the Dee, even as high up as Chester, eighteen miles from the sea, is due to the tide, the "bore" of which collects them from the banks near the mouth of the river. The frothy scum which floats with the tide contains large numbers of forms; but no living specimens have ever been found so far from the sea. These shells are deposited in streaks, and between ripple marks, upon the banks by the receding tide; beautifully clean and prolific gatherings being always obtainable from these places.

I can offer no detailed information respecting the Rhizopodal fauna of the River Mersey. Beyond an occasional scraping of the sands at Eastham and at New Brighton, and the observation of numerous Foraminiferal shells in both

places, I have made no attempt at an examination of that part of the district.

Details as to localities and relative frequency of occurrence of the various species enumerated are appended below in a tabular form; and more extended notes are given upon some of the most interesting forms. The references in the table are to the plates and figures in Mr. Brady's "Challenger" monograph. In the few instances where no figure is there given I have given a reference in the extended notes.

The list includes 162 species and varieties, of which three species are now for the first time named and figured. Messrs. Balkwill and Wright's list of Dublin Bay Foraminifera enumerates 148; 112 of these are to be found in both lists. The forms found in one locality, but not the other, are as under:—

| Foraminifera included in "Dublin Bay and Irish Sea" list, but not yet observed in the "L. M. B. C. district." | Foraminifera included in the "L. M. B. C. district," but not yet observed in "Dublin Bay and Irish Sea." |
|---|---|
| *Biloculina ringens*, var. | *Lieberkühnia wageneri*. |
| *Miliolina tenuis*. | *Shepheardella tæniformis*. |
| *Ophthalmidium carinatum*. | *Gromia dujardinii*. |
| *Cornuspira foliacea*. | " *oviformis*. |
| *Haplophragmium glomeratum*. | *Squamulina lævis*. |
| " *pseudospirale*. | *Nubecularia lucifuga*. |
| " *agglutinans*. | *Biloculina elongata*. |
| *Trochammina inflata*, var. | *Spiroloculina excavata*. |
| *Textularia gramen*. | *Miliolina boueana*. |
| " *globulosa*. | " *venusta*. |
| *Spiroplecta biformis*. | " *spiculifera*, n. sp. |
| *Gaudryina filiformis*. | *Ophthalmidium inconstans*. |
| *Bulimina subteres*. | *Dendrophrya radiata*. |
| *Bolivina textilarioides*. | " *erecta*. |
| " *dilatata*. | *Haliphysema tumanowiczii*. |
| *Lagena lineata*. | *Reophax findens*. |

*Lagena curvilineata*, n. sp.
" *crenata.*
" *lagenoides.*
" *carinata.*
" *castrensis.*
*Nodosaria raphanus.*
" *consobrina.*
*Lingulina carinata.*
*Rhabdogonium tricarinatum.*
*Vaginulina linearis.*
*Polymorphina fusiformis.*
" *rotundata.*
" *myristiformis.*
*Globigerina inflata.*
*Pullenia quinqueloba.*
*Discorbina bertheloti.*
" *wrightii.*
" *parisiensis.*
*Pulvinulina karsteni.*
" *menardii.*
*Gypsina vesicularis.*
*Nonionina pauperata*, n. sp.
*boueana.*

*Reophax moniliforme*, n. sp.
" *nodulosa.*
*Placopsilina bulla.*
" *kingsleyi*, n. sp.
*Textularia agg.* var. *porrecta.*
" *variabilis.*
*Bulimina elegans.*
" *squamigera.*
*Bolivina pygmæa.*
" *œnariensis.*
*Lagena lyelli.*
" *gracillima.*
" *apiculata.*
" *distoma.*
" *lucida.*
" *ornata.*
*Polymorphina æqualis.*
" *communis.*
" *thouini.*
" *lanceolata.*
*Uvigerina canariensis.*
*Sphæroidina dehiscens.*
*Spirillina margaritifera.*
" *limbata.*
*Discorbina ochracea.*
" *biconcava.*
" *turbo.*
*Truncatulina haidengerii.*
" *ungeriana.*
" *refulgens.*
*Pulvinulina repanda.*
" *canariensis.*
*Nonionina asterizans.*
" *umbilicatula.*

## Notes on Liverpool Bay Foraminifera.

*Lieberkühnia wageneri*, Claparède.

Claparède and Lachmann, *Etudes sur les Infusoires et les Rhizopodes, Geneva*, 1850-1861.

Carpenter, *Introduction to the Study of the Foraminifera.*

Siddall, *Quarterly Journal of Microscopical Science*, April, 1880, pl. xvi, figs. 8-12.

This very interesting Rhizopod is occasionally quite common in Colwyn Bay. The delicacy of the membranous "test" is such that the organism is quite unrecognisable when dead. But if small colonies of living Polyzoa or Hydrozoa be placed in glass bottles in clear sea water, and allowed to stand undisturbed for a few days (even weeks sometimes), this and many other Rhizopoda may frequently be obtained from the sides of the bottle, from whence, as already stated, they are easily transferred to a trough or slide for microscopical study by means of a camel hair pencil, the point of which has been reduced to but a few hairs, or by a small pipette. The early spring I have always found to be the best period of the year to obtain these or other living Rhizopoda.

The very fine specimen of *Lieberkühnia* which I have figured as quoted above, was mounted in glycerine jelly prior to drawing fig. 12, which is a representation in optical section, × 1,000 diameters, showing, besides other parts, the transparent integument beset by short rod-like spicules. The presence of these led Dr. Carpenter, in the latest edition of his *Microscope and its Revelations*, to suggest that this was not the typical species. But I find that the spicules are due to a crystallisation from the mounting medium. They are not present on the many living examples I have examined since.

Habitat.—Colwyn Bay, near Little Orme's Head, on Algæ and Hydrozoa, &c., from low water.

*Shepheardella tæniformis*, Siddall.

Siddall, *Quarterly Journal of Microscopical Science*, April, 1880; pl. xv, xvi.

The "test" of this remarkable form, as in the last species, is only membranous; and this may account for the fact that no record, except the above, has ever been made of its appearance in British or foreign seas. The only way to obtain it is by searching on the sides of bottles in which have been kept the finer marine Algæ and Hydrozoa, &c. From such a source I obtained last year, in examples from Colwyn Bay, a specimen which measured two inches in length when stretched out on the bottle side. It looked just like a very delicate pale yellow hair, from each end of which was extended a ramifying network of vigorous pseudopodia. This specimen, after examination, I mounted and still have in my cabinet.

Habitat.—On Hydrozoa, &c., dredged in Colwyn Bay. Frequent in spring at Tenby.

*Gromia dujardinii* and *G. oviformis*.

*Gromia oviformis*, Dujardin, 1835. *Ann. des. Sci. Nat.*, sér. 2, vol. iii, p. 313, and vol. iv, p. 345, pl. 9, fig. 1.

*Gromia dujardini*, Max Schultze, 1854. *Ueber den Organ. Polythal.*, p. 55, pl. 7, figs. 1-7.

Although generally distributed among shore Foraminifera, *Gromia* is, so far as my observation goes, more at home in brackish water than in the sea. In the tide pools left upon the muddy shore of the Dee, near Holywell, I have on several occasions found both species *living* in great abundance, in company with numerous other very varied forms. A careful scraping of the surface of the mud at the bottom of such pools is sure to yield, after resting awhile in a bottle of sea water, a rich harvest of living Rhizopoda. If the sun has been shining upon the pool for a short time, so much the better, as thin flakes of mud then rise to the surface of

the water, and may readily be skimmed off with the organisms upon them.

The test is rare among shells obtained by the usual process of drying and floating from sand. Firstly because the form is most frequent on *mud*, and secondly owing to the great tenuity of the test, which is little more than membranous, and generally collapses when dry.

Habitat.—Muddy shores round the coast generally.

*Squamulina lævis*, Schultze.

A minute scale-like form, round, or irregular in outline, and with simple, often central, circular orifice, occurs occasionally on the polypidoms of Zoophytes from the coast generally. I have also collected living examples. It corresponds most nearly to the above named species.

*Nubecularia lucifuga*, Defr.

I have referred provisionally to the genus *Nubecularia*, several obscure adherent and detached forms from the mouth of the Dee and other localities in the district, but I am in some doubt as to whether they are not merely aberrant examples of other genera.

*Biloculina ringens*, Lamk.

This species is generally distributed round the coast, but by no means common. It occurs also in the river Dee. The allied species *B. elongata*, d'Orb. and *B. depressa*, d'Orb. are of much more frequent occurrence.

*Spiroloculina* spp., d'Orb.

*S. limbata*, *S. planulata*, and *S. excavata*, occur sparingly over the whole area included within the limits of the Committees' observations, extending even in weaker form into the estuary of the Dee, from which locality I have also obtained a single example of the rare form *S. acutimargo*, Brady. Messrs. Balkwill and Wright also report the occurrence of this species in Dublin Bay.

*Miliolina* spp., Will.

Of this genus, the species *M. oblonga*, *M. seminulum*, and *M. subrotunda*, are common throughout the whole district. Very interesting chitinous brackish water examples of the latter species occur in the river Dee. *M. secans* and *M. bicornis* are rather less frequent. *M. trigonula* is generally distributed but not common. The allied form *M. tricarinata* is very rare, and has been found only at the mouth of the Dee. Of *M. venusta* and *M. boueana*, a single scarcely typical example of each has been obtained from the same locality. *M. agglutinans* is sparingly distributed over the whole district. *M. fusca* occurs in the river Dee.

*Miliolina spiculifera*, n.sp. (Pl. I, fig. 3).

The only remaining species of *Miliolina* does not appear to have been previously noticed. It is an elongated form allied to *M. agglutinans*, and has a "test" composed entirely of sponge spicules. The selective habit so indicated, has, in reference to other genera, been considered sufficient to warrant a separate specific name. I have, therefore, named this form *M. spiculifera*. A single example only, from the estuary of the Dee, has yet been obtained (see Pl. I, fig. 3).

*Ophthalmidium inconstans*, Brady.

In the paper above referred to, Messrs. Balkwill and Wright also record the occurrence, generally round the Irish coast, of a small species of *Ophthalmidium* not previously described. The genus had not been noticed before in British seas; so it is an addition to our British fauna. They figure and describe the species as *O: carinatum*, nov. sp. I have found several examples of a somewhat similar form in the Dee estuary, but they do not appear to me specifically distinct from *O. inconstans*, Brady.

*Cornuspira involvens*, Reuss.

This form is generally distributed, but I have not yet

found a single example of the more exclusively marine form *C. foliacea*, Philippi. This is a form which should be sought for in subsequent examination of dredged material.

*Dendrophrya* spp., Strethill Wright.*

"Test adherent, consisting of a sessile chamber with erect or spreading arms. Arms tubular, erect, often branching, with apertures at the distal ends. Walls chitinous, coated with mud."—Brady. *Dendrophrya* is quite common along the N. Wales coast, especially in low water pools near the Little Ormes Head. Its branching, interlacing, muddy tubes frequently cover the whole surface of the polypidoms of Polyzoa and Hydrozoa. I have found both host and Rhizopod living and active together on many occasions, and I do not doubt the genus is equally common in similar localities, *i.e.*, muddy places, round the coast generally. And yet, as Mr. Brady observes, "the genus appears to have remained entirely unnoticed by Rhizopodists." The description and figures given in the Challenger Report are from specimens obtained from the West Coast of Scotland, by Mr. D. Robertson of Glasgow, who sought specially for them at the request of Mr. Brady. Wright describes the "sarcode of the organism as differing from that of other Rhizopods, in being filled with delicate short fibres instead of the usual molecular matter, and containing both within the shell and tubes the highly refractive bodies I have mentioned in a former paper as ova."† The occurrence of the genus in some quantity in a locality which is the annual health resort of many of our local students of Natural History, offers special inducements

* Wright, *Ann. and Mag. of Natural History*, ser. 3, vol. viii, p. 122, pl. iv, figs. 4, 5. H. B. Brady, *Report on the Foram.*, vol. ix, "Challenger" Reports, p. 237, pl. xxxviia, figs. 7–9, 10–12.

† On the Reproductive Elements of the Rhizopoda, *Ann. and Mag. Nat. Hist.*, ser. 3, vol. vii, 1861, p. 360.

to follow up the suggestion here made. Further careful observation of this form could hardly fail to be productive of most valuable results. There is probably no point in Zoology bearing on which there has been less reliable information accumulated, or on which information is more desirable than the reproduction and life history of the members of the Class Rhizopoda.

Examples of both species, *D. radiata* and *D. erecta*, occur in the locality named, but they merge so insensibly into each other that it seems to me impossible to define the limits of either.

*Technitella legumen*, Norman.

A few specimens of this very curious little form, the test of which is entirely built up of sponge spicules, have been found in material from the estuary of the Dee.

*Psammosphæra fusca*, Schultze.

The specimens of this form are small and rare in our district, and hardly typical.

*Hyperammina elongata*, Brady.

Messrs. Balkwill and Wright (Recent Dublin Foraminifera) say of this :—" Large and very abundant at Lambay, muddy bottom ; also met with in other places in Irish Sea." The few specimens I have seen are small and weak.

*Haliphysema tumanowiczii*, Bowerbank.

Typical examples of this remarkable form are frequently to be found in the same prolific corner of Colwyn Bay, near to the Little Ormes Head, already quoted as the special habitat of other rare species. I have found it there on several different occasions, always fixed upon the polypidom of *Cellularia avicularia*.

*Reophax* spp., Montfort.

*R. fusiformis* and *R. scorpiurus*, are rare among those

gatherings or dredgings. *R. nodulosa*, is very rare. *R. findens*, the typical "split" or divided form, is exceedingly rare; one perfect example being all I have ever seen.

*Reophax moniliforme*, n.sp. (Pl. I, fig. 2).

There occur here quite frequently, fragments of an unbranched cylindrical moniliform *Reophax*, which closely resembles *R. findens*, but is not divided. Perfect specimens of this form are rare, but I have found several. Balkwill and Wright figure fragments of the form in question on pl. xiii, figs. 22, 24, of their *Recent Dublin Foraminifera*, but they do not give it a specific name. I venture, therefore, to propose for it, for convenience sake, the name *R. moniliforme* (see Pl. I, fig. 2).

*Placopsilina* spp., d'Orb.

The first examples obtained from this district of the forms I have referred to the genus *Placopsilina*, were adherent to a *Sertularia* dredged from the Dee estuary, off Hilbre Island, by Mr. A. O. Walker. They do not perfectly harmonise with the generic description in Mr. Brady's monograph; being somewhat more delicate and hardly as smooth on the exterior surface as the type forms. The single-chambered globular or ovoid form agrees fairly with *P. bulla;* the specific distinction of which is the monothalamous character.

*Placopsilina kingsleyi*, n.sp. (Pl. I, fig. 1).

On the same *Sertularia* referred to above, and frequently also from the same and other localities, I have obtained a double chambered form which seems intermediate between *P. bulla* and *P. cenomana.* This is figured on plate I, fig. 1, and as a distinguishing name for it, I venture to propose *P. kingsleyi*, in honour of the late Canon Kingsley, the founder of the Chester Society of Natural Science, and the friend and helper of all men.

*Ammodiscus* spp., Reuss.

*A. incertus* occurs rarely in shore gatherings and dredgings, and is sometimes very fine. *A. gordialis* and *A. charoides* are much more rare. *A. shoneanus* is also very rare, but it is interesting to note that since it was first recorded from the river Dee in 1878 (Siddall, *Proceedings of Chester Society Nat. Sci.*, part ii, p. 46, figs. 1, 2), it has been recorded by several observers from the coast of Ireland, and by Mr. H. B. Brady from 120 fathoms, off Christmas Harbour, Kerguelen Island, and from 3,950 fathoms—the very deepest part—in the North Pacific.

*Trochammina* spp., P. and S.

*T. nitida* and *T. inflata* are both generally distributed, but nowhere common in the district. *T. macrescens*, which is apparently but a feeble brackish-water form of *inflata*, occurs occasionally in the Dee.

*Textularia* spp., Defrance.

Further examination of dredgings and shore-gatherings will probably yield other species of this genus. The examples I have so far obtained do not include several that have been found on the opposite Irish coast.

*Verneuilina* spp., d'Orb.

The arenaceous form *V. polystropha* is generally distributed over the district; but of *V. spinulosa* only a single enfeebled example has yet been found. It is more essentially a deep-water form.

*Bigenerina digitata*, d'Orb.

Examples of this form are rare and small, but typical.

*Bulimina* spp., d'Orb.

The type form of *Bulimina*, viz., *B. pupoides*, is frequent at all depths, *B. elegans* and *B. elegantissima* are much less common. The remaining species are rarely met with. Of

*B. squamigera* I have only a single example, of the identity of which I am not at all assured.

*Virgulina schreibersii*, Cygjek.

Very rare, but specimens typical.

*Bolivina* spp., d'Orb.

*B. ænariensis*, Costa, was erroneously described in the Foraminifera of the River Dee, as *B. costata*, d'Orb.

*Cassidulina* spp., d'Orb.

*C. lævigata* and *C. crassa* are both of rare occurrence and feeble development in the district.

*Lagena* spp., Walker and Jacob.

The beautiful genus *Lagena* is represented by a great variety of forms, every one of which has been found to extend even into the brackish water of the River Dee. *L. sulcata* and *L. lævis* are universal and are common everywhere round the coast. The species *L. semistriata*, *L. striata*, *L. marginata*, *L. squamosa*, *L. lucida*, and *L. apiculata* are also general, but much less common. The remaining species have not yet been observed in our district beyond the estuary of the Dee. Previous to its occurrence in the Dee *L. aspera* had only been known as a Tertiary fossil form. *L. gracilis*, *L. orbignyana*, *L. ornata*, *L. pulchella*, and *L. hispida* are also exceedingly rare. The twenty-nine species named in this list do not include all those known as British, and it is very probable that further observations will considerably extend the list.

*Nodosaria* spp., Lamk.

Of this genus all the six species observed are of general distribution, excepting only *N. hispida*, of which I have seen only one specimen, and that a broken one, from the river Dee, near Hilbre Island. Uncertainty as to its name caused me to omit it from the List of Dee Foraminifera, but Messrs.

Balkwill and Wright describe and figure it in their admirable list of Dublin Foraminifera. Their two specimens were obtained respectively from off the Hen and Chickens, Isle of Man, and between the Isle of Man and the Mourne mountains.

*Marginulina* spp., d'Orb.

Both *M. costata* and *M. glabra* are very rare. Of the latter I have several very fair examples, but only one of the former, and that has its terminal chamber broken.

*Vaginulina legumen*, d'Orb.

*V. legumen* is the only species of the genus I have seen, and of this only a single example.

*Cristellaria* spp., Lamk.

*C. crepidula* is by far the most common of the three species obtained in the district. A very fine example of this species (now in the cabinet of my friend, Mr. W. Shone, F.G.S.), was found by his mother, who was a most indefatigable student of Foraminifera, in material obtained at Hilbre Island. Several of the later chambers of the specimen contain young *Cristellaria*. Most of these consist only of the small globular shell which forms the primary chamber in the genus, but several others have also added a second chamber upon the first. The size of these young forms is such that they could only be liberated upon the breaking up of the parent shell. Mr. Brady has figured this peculiar specimen on pl. lxvii of his "Challenger" Foraminifera, in which work may also be found numerous other examples of a similar viviparous method of reproduction.

*Polymorphina* spp., d'Orb.

*P. lactea*, *P. gibba*, and *P. communis* are generally present in all gatherings. *P. thouini* is a very rare form. *P. spinosa* is exceedingly rare; previous to its discovery in

the Dee, it had only been known as a miocene fossil form. *P. lanceolata* was described as *P. fusiformis* in the Dee catalogue. *P. concava* is a small rare form, concave on one surface and with a wing, or flattened out extension of shell substance surrounding it. It is said to be parasitic; but all our specimens are free. *P. orbignyi* is a name given to several species with numerous irregularly projecting apertures. Mr. Brady does not figure any of the three last-named forms.

*Uvigerina* spp., d'Orb.

*U. pygmæa* and *U. angulosa* are of frequent occurrence, and generally distributed. *U. canariensis* (*U. irregularis*, Brady, Dee catalogue) is very rare.

*Orbulina*, d'Orb.

I have several examples of what I take to be this form from the River Dee, which are brown and chitinous, but not perfectly calcareous. This imperfectly calcified condition is frequent among the porcellanous group Miliolidæ, but very unusual in the Perforata.

*Globigerina bulloides*, d'Orb.

General, but never common.

*Pullenia sphæroides*, d'Orb.

Is very diminutive, and very rare. Only Dee specimens observed.

*Sphæroidina dehiscens*, P. and J.

Essentially a deep water form; very small and feeble with us. Only one example from Dee estuary found.

*Spirillina* spp., Ehrenb.

All the four species of this genus are rare. Of *S. margaritifera*, I have only one specimen, which I obtained in a tow-net from the "bore" of the tide at Chester. *S. tuberculata* is also very rare, and was first described (though not

first discovered) in the Dee catalogue, from Mr. Brady's MS. notes. *S. limbata* is very rare.

*Patellina corrugata*, Will.

A very pretty, distinct, and well-marked form, which is frequent, though very small in our district.

*Discorbina* spp., P. and J.

*D. globularis* is common everywhere in the district. *D. ochracea* was figured and described by Prof. Williamson, in his *Recent Foraminifera of Great Britain;* but is not figured or described by Mr. Brady. *D. biconcava* is a well-marked form, which when found in the Dee, was new to the British Fauna. *D. tuberculata* is figured and described by Messrs. Balkwill and Wright in the Dublin catalogue. It is a rare but distinct form, studded with large tubercles, each of which is perforated in the only specimen I have found.

*Planorbulina mediterranensis*, d'Orb.

Is very distinct and well developed, and frequent over the whole district. I have also found two of the very singular rolled-up forms of the shell.

*Truncatulina* spp., d'Orb.

*T. lobatula* is one of the common shells of the district; the other three species are rare, and barely typical.

*Pulvinulina* spp., P. and J.

This is essentially a deep water genus, and the forms we get in the district are always feeble and ill-developed.

*Rotalia* spp., Lamk.

*R. beccarii* is as common as possible, and occurs in abundance in every locality. *R. nitida* is probably only its young state.

*Gypsina inhærens*, Schultze.

Described as *Tinoporus lucidus* in the Dee list. It is very rare in the district.

*Nonionina* spp., d'Orb.

*N. depressula* is very common. All the others are rare, and none of them well-developed.

*Polystomella* spp., Lamk.

*P. striata-punctata* is present in abundance everywhere,—*P. crispa* is comparatively rare.

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The following Table gives a complete list of the species and varieties which have been observed in the district, with their localities and indications of their relative frequency of occurrence.

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EXPLANATION OF PLATE I.

Fig. 1.—*Placopsilina kingsleyi*, n.sp., attached to a *Sertularia*, × 40 diameters.

Fig. 2.—*Reophax moniliforme*, n.sp., × 50 diameters.

Fig. 3.—*Miliolina spiculifera*, n.sp., × 100 diameters.

## List of the Liverpool Bay Foraminifera.

# SUB-KINGDOM—PROTOZOA.

## Class—Rhizopoda.

## ORDER—FORAMINIFERA (RETICULARIA).

### Family I.—Gromidæ.

Test membranous and flexible, or chitinous and rigid; imperforate.

| | Plate. (In Mr. Brady's Monograph.) | Fig. | Remarks. |
|---|---|---|---|
| *Lieberkühnia.* Claparède | | | |
| *waaeneri.* Clap. ... ... | | | Colwyn Bay, rare. |
| [illegible] Siddall Sid. ... ... ... | | | Colwyn Bay, very rare. |
| *Gromia.* Dujardin | | | |
| *dujardinii.* Schultze ... ... | | | River Dee, rare. |
| *oviformis.* Duj. ... ... ... | | | River Dee, frequent. |

### Family II.—Miliolidæ.

"Test imperforate, normally calcareous and porcellanous, sometimes encrusted with sand, under starved conditions (*e.g.*, in brackish water) becoming chitinous or chitino-arenaceous."

#### Sub-Family 1.—Nubecularinæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Squamulina.* Schul. | | | |
| *lævis.* Schul. ... ... ... | | | Colwyn Bay, on Zoophytes, very rare. |
| *Nubecularia.* Defrance | | | |
| *lucifuga.* Defr. ... ... ... | I | 9-16 | Colwyn Bay, on Zoophytes, specimens very obscure and doubtful. |

Sub-Family 2.—MilioliDæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Biloculina.* D'Orb. | | | |
| *ringens.* Lamk. ... ... ... | II | 7-8 | Colwyn Bay, and general, but not common. |
| *depressa.* D'Orb. ... ... ... | II | 15-17 | Generally distributed round Coast. |
| *elongata.* D'Orb. ... ... ... | II | 9 | Generally distributed round Coast. |
| *Spiroloculina.* D'Orb. | | | |
| *limbata.* D'Orb. ... ... ... | IX-X | 15-7, 1-2 | Not at all common anywhere round the North Wales Coast. |
| *planulata.* D'Orb. ... ... ... | IX | 11 | |
| *excavata.* D'Orb. ... ... ... | IX | 5-6 | |
| *acutimargo.* Brady ... ... | X | 12-15 | Estuary of Dee, very rare. |
| *Miliolina.* Will. | | | |
| *trigonula.* Lamk. ... ... ... | III | 14-16 | Dee, Colwyn, and Llandudno, rare. |
| *tricarinata.* D'Orb. ... ... | III | 17 | Dee, Colwyn, and Llandudno, very rare. |
| *oblonga.* Montagu... ... ... | V | 4 | Frequent everywhere. |
| *boueana.* D'Orb. ... ... ... | VII | 13 | Estuary of Dee, very rare, a doubtful example. |
| *seminulum.* Linn ... ... ... | V | 6 | General. |
| *venusta.* Karrer ... ... ... | V | 5-7 | Same remarks apply as to *M. boueana.* |
| *subrotunda.* Mont. ... ... | V | 10-11 | Very common, some of river Dee specimens chitinous only. |
| *secans.* D'Orb. ... ... ... | VI | 1-2 | A moderately common form. |
| *bicornis.* W. & J. ... ... | VI | 9, 11, 12 | A moderately common form. |
| *ferussacii.* D'Orb. ... ... | CXIII | 17 | One specimen from Dee Estuary only. |
| *fusca.* Brady ... ... ... | | | Rare in Dee. |
| *agglutinans.* D'Orb. ... ... | VIII | 6, 7 | Rare in Dee and Colwyn. |
| *spiculifera*, n. sp. ... ... ... | | | Estuary of Dee, a good example only. |

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| | **Sub-Family 3.—Haueríninæ.** | | |
| *Ophthalmidium.* Kubler | | | |
| *inconstans.* Brady... ... ... | XII | 5, 7, 8 | Rare, Estuary of Dee. |
| | **Sub-Family 4.—Peneroplidinæ.** | | |
| *Cornuspira.* Schul. | | | |
| *involvens.* Reuss. ... ... ... | XI | 1-3 | Not common, but generally distributed. |

## Family III.—Astrorhizidæ.

"Test invariably composite, usually of large size and monothalamous"—built up of sand grains, sponge spicules, or particles of mud, &c.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| | **Sub-Family 1.—Astrorhizinæ.** | | |
| *Dendrophrya.* Strethill Wright | | | |
| *radiata.* S. Wright ... ... | XXVIIA | 10-12 | Colwyn Bay, frequent on Zoophytes. |
| *erecta.* S. Wright ... ... ... | XXVIIA | 7-9 | |
| | **Sub-Family 2.—Pilulininæ.** | | |
| *Technitella.* Norman | | | |
| *legumen.* Norman ... ... ... | XXV | 8-12 | Estuary of Dee, very rare. |
| | **Sub-Family 3.—Saccammininæ.** | | |
| *Psammosphæra.* Schul. | | | |
| *fusca.* Schul. ... .. ... | XVIII | 1-8 | Specimens doubtful. |
| | **Sub-Family 4.—Rhabdammininæ.** | | |
| *Hyperammina.* Brady | | | |
| *elongata.* Brady ... ... ... | XXIII | 4, 7-10 | Very rare. |
| *Haliphysema.* Bowerbank | | | |
| *tumanowiczii.* Bow. ... ... | XVIIA | 4-5 | Colwyn Bay. |

## Family IV.—Lituolidæ.

"Test arenaceous, usually regular in contour. Comprises sandy isomorphs of many porcellanous and hyaline forms, together with some adherent species."

### Sub-Family 1.—Lituolinæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Reophax.* Montfort | | | |
| *fusiformis.* Will. ... ... ... | xxx | 7-11 | Rare. |
| *scorpiurus.* Montf. ... ... | xxx | 12-17 | Rare. |
| *findens.* G. M. Dawson ... .. | xxxii | 10, 11 | Typical form, very rare. |
| *moniliforme*, n. sp. ... ... | | | |
| *nodulosa.* Brady .. ... ... | xxxi | 1-9 | Very rare. |
| *Haplophragmium.* Reuss | | | |
| *globigeriniforme.* P. & J. ... | xxxv | 10, 11 | Very rare. |
| *canariensis.* D'Orb. .... ... | xxxv | 1-5 | Frequent. |
| *Placopsilina.* D'Orb. | | | |
| *bulla.* Brady ... ... ... | xxxv | 16, 17 | Very rare, examples not typical. |
| *kingsleyi*, n. sp. ... ... ... | | | Rare. |

### Sub-Family 2.—Trochammininæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Ammodiscus.* Reuss | | | |
| *incertus.* D'Orb. ... ... ... | xxxviii | 1-3 | Estuary of Dee, rare. |
| *gordialis.* J. & J. ... ... ... | xxxviii | 7-9 | Estuary of Dee, very rare. |
| *charoides.* P. & J.... ... ... | xxxviii | 10-16 | Estuary of Dee, very rare. |
| *shoneanus* Sid. ... ... .. | xxxviii | 17-19 | Estuary of Dee, very rare. |
| *Trochammina.* P. & J. | | | |
| *nitida.* Brady ... ... ... | xli | 5, 6 | Rather rare. |
| *inflata.* Mont. ... ... ... | xli | 4 | Rather rare. |
| *macrescens.* Brady ... ... | | | Rather rare. |

## Family V.—Textularidæ.

"Tests of larger species arenaceous, with or without a perforate calcareous basis; smaller forms hyaline and conspicuously perforate. Chambers arranged in two or more alternating series, more rarely spiral or confused, often dimorphous."

### Sub-Family 1.—Textularinæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Textularia.* Defr. | | | |
| *sagittula.* Defr. ... ... ... | XLII | 17, 18 | Rare. |
| *agglutinans.* D'Orb. ... ... | XLIII | 1-3 | Rare. |
| var. *porrecta.* Brady ... ... | XLIII | 4 | Very rare. |
| *variabilis.* Will. ... ... ... | | | Frequent. |
| *Verneuilina.* D'Orb. | | | |
| *polystropha.* Reuss ... ... | XLVII | 15-17 | Rare. |
| *spinulosa.* Reuss ... ... ... | XLVII | 1-8 | Very rare. |
| *Bigenerina.* D'Orb. | | | |
| *digitata.* D'Orb. ... ... ... | XLIV | 19-24 | Very rare. |

### Sub-Family 2.—Bulimininæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Bulimina.* D'Orb. | | | |
| *pupoides.* D'Orb. ... ... ... | L | 15 | Frequent. |
| *elongata.* D'Orb. ... ... ... | LI | 1 | Rare. |
| *marginata.* D'Orb. ... ... | LI | 3-5 | Rare. |
| *aculeata.* D'Orb. ... ... ... | LI | 7-9 | Very rare. |
| *ovata.* D'Orb. ... ... ... | L | 13 | Rare. |
| *elegans.* D'Orb. ... ... ... | L | 1-4 | Not common. |
| *elegantissima.* D'Orb. ... ... | L | 20-22 | Not common. |
| *squamigera.* D'Orb. ... ... | | | Very rare. |

Sub-family 2.—Bulimininæ—*continued.*

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Virgulina.* D'Orb. | | | |
| *schreibersiana.* Czjzek ... ... | LII | 1-3 | Very rare. |
| *Bolivina.* D'Orb. | | | |
| *punctata.* D'Orb. ... ... ... | LII | 18-19 | Frequent. |
| *plicata.* D'Orb. ... ... ... | | | Not common. |
| *pygmæa.* D'Orb. ... ... ... | LIII | 5, 6 | Not common. |
| *difformis.* D'Orb. ... ... ... | | | Rare. |
| *ænariensis.* Costa ... ... ... | LIII | 10-11 | Rare. |

Sub-Family 3.—Cassidulininæ.

| | | | |
|---|---|---|---|
| *Cassidulina.* D'Orb. | | | |
| *lævigata.* D'Orb. ... ... ... | LIV | 1-3 | Rare. |
| *crassa.* D'Orb. ... ... ... | LIV | 4, 5 | Rare. |

## Family VII.—Lagenidæ.

"Test calcareous, finely perforated, either monothalamous, or consisting of a number of chambers joined in a straight, curved, spiral, alternating, or (rarely) branching series. Aperture simple or radiate, terminal."

Sub-Family 1.—Lageninæ.

| | | | |
|---|---|---|---|
| *Lagena.* Walker & Jacob | | | |
| *sulcata.* W. & J. ... ... ... | LVII | 23, 33 | Very common. |
| var. *interrupta.* Will. ... ... | LVII | 25, 27 | Very common. |
| var. *costata.* Will. ... ... | | | Very common. |
| var. *williamsoni.* Alcock ... | | | Very common. |
| var. *caudata.* P. & J. ... ... | | | Not common. |

Sub-Family 1.—LAGENINÆ—*continued.*

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Lagena.* Walker & Jacob | | | |
| *lyelli.* Seguenza ... ... ... | | | Very rare. |
| *feildeniana.* Brady ... ... | LVIII | 38, 39 | Very rare. |
| *striato-punctata.* P. & J. . | | | Very rare. |
| *lævis.* Mont. ... ... .. | LVI | 7-12 | Very common. |
| *gracillima.* Seg. ... ... ... | LVI | 19, 28 | Very rare. |
| *apiculata.* Reuss ... ... ... | LVI | 15-18 | Frequent. |
| *globosa.* Mont. ... ... ... | LVI | 1-3 | Frequent. |
| *striata.* D'Orb. ... . ... | LVII | 22, 24 | Common. |
| *gracilis.* Will. ... ... ... | LVIII | 2, 3, 7 | Very rare. |
| *semistriata.* Will. ... ... ... | LVII | 14, 16, 17 | Common. |
| *distoma.* P. & J. . . ... ... | LVIII | 11-15 | Very rare. |
| *aspera.* Reuss ... ... ... | LVII | 6-12 | Very rare. |
| J. ... ... | LIX | 21-23 | Common. |
| ... ... ... | LIX | 24-26 | Very rare. |
| P. & J. ... | LXI | 12, 13 | Very rare. |
| ... ... ... | | | Frequent. |
| *trigono-oblonga.* Seg. & Sid. ... | LXI | 11 | Rare. |
| *ornata.* Will. ... ... ... | | | Very rare. |
| *trigono-ornata.* Brady ... | LXI | 14 | Very rare. |
| *pulchella.* Brady ... .. ... | | | Very rare. |
| *melo.* D'Orb. ... .. ... | | | Common. |
| *squamosa.* Mont. ... ... ... | LVIII | 28-31 | Common. |
| *hexagona.* Will. ... ... ... | LVIII | 32, 33 | Common. |
| *hispida.* Reuss ... ... ... | LVII | 1-4 | Very rare. |

Sub-Family 2.—NODOSARINÆ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Nodosaria.* Lamk. | | | |
| *scalaris.* Batsch ... ... ... | LXIII | 28-31 | Frequent. |
| *radicula.* Linn. ... ... ... | LXI | 28-31 | Very rare. |
| *hispida.* D'Orb. ... ... ... | LXIII | 12-16 | Very rare. |
| *pyrula.* D'Orb. ... ... ... | LXII | 10-12 | Frequent. |
| (*Dentalina*) | | | |
| *communis.* D'Orb. ... ... | LXII | 19-22 | Frequent. |
| *obliqua.* D'Orb. ... ... ... | LXIV | 20-22 | Rare. |
| *Marginulina.* D'Orb. | | | |
| *costata.* Batsch ... ... ... | LXV | 10-13 | Very rare. |
| *glabra.* D'Orb. ... ... ... | LXV | 5, 6 | Very rare. |
| *Vaginulina.* D'Orb. | | | |
| *legumen.* Linn. ... ... ... | LXVI | 13-15 | Very rare. |
| *Cristellaria.* Lamk. | | | |
| *rotulata.* Lamk. ... ... ... | LXIX | 13 | Rare. |
| *crepidula.* F. & M. ... ... | LXVII | 17, 19 | Frequent. |
| *italica.* Defr. ... ... ... | LXVIII | 20-23 | Rare. |

Sub-Family 3.—POLYMORPHININÆ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Polymorphina.* D'Orb. | | | |
| *lactea.* W. & J. ... ... ... | LXXI | 11, 14 | Frequent. |
| var. *oblonga.* Will. ... ... | | | Frequent. |
| *gibba.* D'Orb. ... ... ... | LXXI | 12 | Frequent. |
| *subæqualis.* D'Orb. ... ... | | | Frequent. |
| *communis.* D'Orb. ... ... | LXXII | 19 | Frequent. |
| *thouini.* D'Orb. ... ... ... | LXXII | 18 | Very rare. |

Sub-Family 8.—POLYMORPHININÆ—*continued.*

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Polymorphina.* D'Orb. | | | |
| *compressa.* D'Orb. | LXXII | 9-11 | Frequent. |
| *lanceolata.* Reuss | LXXII | 5, 6 | Rare. |
| *concava.* Will. | | | Rare. |
| *spinosa.* D'Orb. | | | Very rare. |
| *orbignyii.* Zborzewskii | | | Rare. |
| *Uvigerina.* D'Orb. | | | |
| *pygmea.* D'Orb. | LXXIV | 11-14 | Frequent. |
| *angulosa.* Will. | LXXIV | 15-18 | Frequent. |
| *canariensis.* D'Orb. | LXXIV | 1-3 | Rare. |

Family VIII.—GLOBIGERINIDÆ.

"Test free, calcareous, perforate; chambers few, inflated, arranged spirally; aperture single or multiple, conspicuous."

Sub-Family 1.—GLOBIGERINÆ.

| | | | |
|---|---|---|---|
| *Orbulina.* D'Orb. | | | |
| *universa.* D'Orb. | LXXVIII | 8-26 | Rare. |
| *Globigerina.* D'Orb. | | | |
| *bulloides.* D'Orb. | LXXVII | 3-7 | Frequent. |
| *Pullenia.* P. & J. | | | |
| *sphæroides.* D'Orb. | LXXXIV | 12, 13 | Very rare. |
| *Sphæroidina.* D'Orb. | | | |
| *dehiscens.* P. & J. | LXXXIV | 8-11 | Very rare. |

## Family IX.—Rotalidæ.

"Test free or adherent, calcareous, perforate; typically spiral and 'Rotaliform,' *i.e.*, whole of the chambers visible on the superior surface, those of the last convolution only on the inferior (apertural) surface."

### Sub-Family 1.—Spirillininæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Spirillina.* Ehrenb. | | | |
| *vivipara.* Ehrenb ... ... ... | LXXXV | 1-5 | Rare. |
| *margaritifera.* Will. ... ... | | | Very rare. |
| *tuberculata.* Brady ... ... | LXXXV | 12-16 | Very rare. |
| *limbata.* Brady ... ... ... | LXXXV | 18-21 | Very rare. |

### Sub-Family 2.—Rotalinæ.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Patellina.* Will. | | | |
| *corrugata.* Will. ... ... ... | LXXXVI | 1-7 | Frequent. |
| *Discorbina.* P. & J. ... ... ... | | | |
| *rosacea.* D'Orb. ... ... ... | LXXXVII | 1-4 | Frequent. |
| *ochracea.* Will. ... ... ... | | | Rare. |
| *globularis.* D'Orb. ... ... | LXXXVI | 8-13 | Common. |
| *orbicularis.* Terquem ... ... | LXXXVIII | 4-8 | Rare. |
| *biconcava.* P. & J. ... ... | XCI | 2, 3 | Very rare. |
| *turbo.* D'orb. ... ... .. | LXXXVII | 8 | Rare. |
| *tuberculata.* Balkwill & Wright ... | | | Very rare, one specimen from Dee only. |
| *Planorbulina.* D'Orb. | | | |
| *mediterranensis.* D'Orb. ... ... | XCII | 1-3 | Common. |
| *Truncatulina.* D'Orb. | | | |
| *haidengerii.* D'Orb. ... ... | XCV | 7 | Rather rare. |
| *ungeriana.* D'Orb. ... ... | XCIV | 9 | Rather rare. |

Sub-Family 2.—ROTALINÆ—*continued*.

| | Plate. | Fig. | Remarks. |
|---|---|---|---|
| *Truncatulina.* D'Orb. | | | |
| *lobatula.* Walker ... ... ... | XCII | 10 | Very common. |
| *refulgens.* Montf. ... ... ... | XCII | 7-9 | Rare. |
| *Pulvinulina.* P. & J. | | | |
| *repanda.* F. & M.... ... ... | CIV | 18 | Not common. |
| *auricula.* F. & M. ... ... | CVI | 5 | Rare. |
| *canariensis.* D'Orb. .. ... | CIII | 8-10 | Very rare. |
| *Rotalia.* Lamk. | | | |
| *beccarii.* Linn. ... ... ... | CVII | 2, 3 | Very common. |
| *nitida.* Will. ... ... ... | | | Common. |

Sub-Family 3.—TINOPORINÆ.

| | | | |
|---|---|---|---|
| *Gypsina.* Carter | | | |
| *inhærens.* Schul. .. ... ... | CII | 1-6 | Very uncommon. |

Family X.—NUMMULINIDÆ.

"Test typically free, polythalamous, symmetrically spiral; calcareous and finely tubulated."

Sub-Family 2.—POLYSTOMELLINÆ.

| | | | |
|---|---|---|---|
| *Nonionina.* D'Orb. | | | |
| *asterizans.* F. & M. ... ... | CIX | 1, 2 | Rare. |
| *turgida.* Will. ... ... ... | CIX | 17-19 | Rare. |
| *scapha.* F. & M. ... ... .. | CIX | 14-16 | Rare. |
| *umbilicatula.* Mont. ... ... | CIX | 8, 9 | Rare. |
| *depressula.* W. & J. ... ... | CIX | 6, 7 | Very common. |
| *stelligera.* D'Orb. ... .. ... | CIX | 3-5 | Rare. |
| *Polystomella.* Lamk. ... ... | | | |
| *crispa.* Linn ... ... ... | CX | 6, 7 | Common. |
| *striato-punctata.* F. & M... ... | CIX | 22, 23 | Very common. |

## REPORT on the PORIFERA of the L. M. B. C. DISTRICT.

By Thos. Higgin, F. L. S.

The following classification will show the systematic position of the species discussed in this Report, while the right hand column will serve as a list of all the species collected.

### PORIFERA (= Class SPONGIDA, Huxley).

#### Order I.—CARNOSA (Carter).

| Family. | Group. | Genus. Species. |
|---|---|---|
| Halisarcida.... | .. ... | *Halisarca dujardinii*, J. |

#### Order III.—PSAMMONEMATA (Carter).

| Family. | Group. | Genus. Species. |
|---|---|---|
| Arenida. | ... *Arenosa*. ... | *Dysidea fragilis*, J. |

#### Order IV.—RHAPHIDONEMATA (Carter).

| Family. | Group. | Genus. Species. |
|---|---|---|
| Chalinida. | ...*Digitata*. ... | *Chalina oculata*, Bk. |
| | *Reptata*. ... | *Chalina limbata*, Bk. |

#### Order V.—ECHINONEMATA (Carter).

| Family. | Group. | Genus. Species. |
|---|---|---|
| Ectyonida. | *Dictyocylindrina*. | *Dictyocylindrus stuposus*, Bk. |
| | *Plumohalichondrina*. | *Plumohalichondria plumosa*, C. |
| | *Echinoclathrina*. ... | *Ophlitaspongia seriata*, Bk. |

#### Order VI.—HOLORHAPHIDOTA (Carter).

| Family. | Group. | Genus. Species. |
|---|---|---|
| Renierida. | ...*Amorphosa*. ... | *Amorphina panicea*, S. |
| | | *Amorphina coccinea*, S. |
| | | *Amorphina albescens*, S. |
| | | *Amorphina caruncula*, S. |

| Family. | Group. | Genus. Species. |
| --- | --- | --- |
| RENIERIDA. ... | *Isodictyosa.* ... | *Isodictya varians*, Bk. |
| | | *Isodictya elegans*, Bk. |
| | | *Isodictya simulans*, Bk. |
| | | *Isodictya pallida*, Bk. |
| | | *Isodictya densa*, Bk. |
| | | *Isodictya fistulosa*, Bk. |
| | | *Isodictya clava*, Bk. |
| | | *Isodictya fucorum*, Bk. |
| | *Halichondrina.* | *Halichondria incrustans*, J. |
| | *Esperina.* ... | *Esperia ægagropila*, C. |
| SUBERITIDA... | *Suberitina.* ... | *Cliona celata*, J. |
| | | *Raphyrus griffithsia*, Bk. |
| | | *Suberites carnosa*, S. |
| | | *Suberites suberea*, S. |
| | | *Hymeniacidon sanguinea*, Bk. |
| PACHYTRAGIDA. | *Geodina.* | *Pachymatisma johnstonia*, Bk. |
| | *Stellettina.* ... | *Ecionema ponderosa*, Bk. |
| | | *Stelletta grubii*, Sdt. |
| PACHASTRELLIDA. | *Pachastrellina.* | *Dercitus niger*, C. |

## Order. VIII.—CALCAREA (Haeckel).

| Family. | Group. | Genus. Species. |
| --- | --- | --- |
| ASCONES. ... | ... ... | *Ascetta coriacea* |
| | | *Ascaltis botryoides* |
| LEUCONES. ... | ... ... | *Leucandra fistulosa* |
| | | *Leucandra gossei* |
| | | *Leucandra nivea* |
| | | *Leucandra johnstonii* |
| SYCONES. ... | ... ... | *Sycandra ciliata* |
| | | *Sycandra compressa* |
| | | *Aphroceras ramosa*, n.sp. |

The arrangement of all Sponges, excepting the Calcarea, followed in these notes is that published by Mr. Carter, in

his "Notes introductory to the study and classification of the SPONGIDA,"* and corresponds with the "teaching collection," arranged by me in the Free Museum, Liverpool, in trays containing examples of all the groups.

The specimens obtained by Professor W. A. Herdman will be alluded to with the letters L. M. B. C., with locality and a number, being part of the collection of the Liverpool Marine Biology Committee, and those found by Mr. T. J. Moore and Mr. Higgin, under the letters L. F. M., being part of the collection of the Liverpool Free Museum.

The specimens in the L. F. M. collection of species, named by Dr. Bowerbank, to which the letter V is attached, were verified by him a few years before his death. This is of considerable importance, because the student finds it very difficult, and in many cases impossible, to recognise Bowerbank's species from his descriptions of them; whilst, in many instances, his illustrations afford no assistance.

## Order I.—CARNOSA.

### Family—HALISARCIDA.

*Halisarca dujardinii*, Johnston.

This interesting species, having no spicules or skeletal parts, was first observed by Dujardin on the coast of Normandy in 1838, and by him it was named *Halisarca*. In 1842 Dr. Johnston found it, and described it in "British Sponges" as *Halisarca dujardinii*. In 1862 Dr. Oscar Schmidt described a new species differing in form and colour from *H. dujardinii*, as *Halisarca lobularis*. In 1847 Nardo described another aspiculous sponge under the generic name of *Chondrosia*, and stated that it had for many years been known to the fishermen of the Mediterranean as *Carume di*

* *Annals and Mag. Nat. Hist.*, 1875; ser. 4, vol. xvi.

*Mar*, and since that time several other species have been described. The different varieties of Carnosa now known, including both aspiculous and spiculous species, have lately been grouped by Mr. H. J. Carter, F.R.S., in two families—Halisarcida and Gumminida (*Annals and Mag. Nat. Hist.*, October, 1881), embracing in all twenty-five species.*

The specimens of *H. dujardinii* found at Holyhead in March, 1873, contained ova in the first stage of development only, that is before any duplicate subdivision had taken place, but those obtained by Mr. Carter in July and August the following year contained ova as well as embryos in every stage of development. The Port Erin examples also, gathered in July and August last year, contained embryos in the later stages of development.

Dr. Bowerbank would not believe in the existence of sponges without any spicules, and assumed that Dr. Johnston was mistaken in not finding spicules in the sponge he described. He has figured a thin coating sponge amongst his Hymeniacidons as *Hymeniacidon dujardinii*, under the impression that this must have been the species Dr. Johnston had described (*Mon. Brit. Spon.*, vol. iii, pl. 38, fig. 1 to 4).†

L. M. B. C., No. 85. 1., near low-water mark, Bay-ny-Carrickey, between Port St. Mary and Poyllvaaish, Isle of Man, Aug. 8., 1885; from *Laminaria* roots on shore between Port St. Mary and Spanish Head, Isle of Man, Aug. 13, 1885; in rock-pools, near Port Erin, Isle of Man, Aug., 1885.

L. F. M., No. 22. 4. 74, 3. Collected at Holyhead.

* See also Carter's papers in 1874 in *Annals and Mag. Nat. Hist.*, "On the Spongozoa of *Halisarca dujardinii*," and "On the *Halisarca lobularis*," also "Development of Marine Sponges," &c., &c., 1874.

† For excellent work on *Halisarca*, with beautiful and faithful plates, see the papers by F. E. Schultze in *Zeitschrift f. wiss. Zoologie*, 1877, Bd. xxviii, and 1879, Bd. xxix.

## Order III.—PSAMMONEMATA.

### Family.—Arenida.

*Dysidea fragilis*, Johnston.

This sponge, which is found all round our coasts, and is widely distributed over other parts of the world, was called *fragilis* by Dr. Johnston* because when dried it is easily made to crumble away. This arises from the nature of its skeletal parts. The skeleton is composed of grains of sand taken up by the sponge from the wash of the tide, and worked into a network by being agglutinated together by a very small quantity of horny material. Consequently when the sponge is dried, the horny matter being in such small proportion, the grains of sand easily become separated and the skeleton breaks up. It is the *Spongelia* of Dr. O. Schmidt.† Only two British representatives of arenaceous sponges have been described. Mr. Carter has placed them in his order Psammonemata, which also contains the "Sponge of Commerce" or "bath sponge," whose skeleton is clear horny material, almost entirely, if not altogether, free from grains of sand. Mr. Carter, however, states that there are always some grains of sand to be found in some parts of the fibre of even the best specimens of "Turkey Sponge." The order, therefore, contains every variety of arenaceous fibre, from *Spongia officinalis* to such sponges as *Dysidea fragilis*.

L. F. M., No. 24. 5. 73. 14. Collected at Holyhead.

## Order IV.—RHAPHIDONEMATA.

### Family.—Chalinida.

*Chalina oculata*, Bk.

*Halichondria oculata*, J.

*Chalina polychotoma*, Carter.

*Spongia polychotoma*, Esper.

* *British Sponges*, p. 187; see also Bowerbank, *Mon. Brit. Spong.*, vol. i, pl. xiv., fig. 270; vol. ii, p. 381, and vol. iii, pl. lxix.

† *Spongienfauna Atlan.*, 1870, p. 77.

This digitate species is representative of Mr. Carter's family Chalinida, and of his order Rhaphidonemata, which embraces all sponges having a horny fibre cored with spicules produced by the sponge.*

L. F. M., No. 29. 12. 61. 1. Collected at Morecambe Bay.

*Chalina limbata*, Bk.

*Spongia Limbata*, Johnston.

This is a *Chalina* of quite different form and appearance from *C. oculata*, but it is distinctly a *Chalina*, a pretty network of horny matter enclosing the acerate spicules of the species. It is a sessile species.†

L. M. B. C., No. 85.2. Collected at Port Erin, Isle of Man.

L. F. M., No. 24. 9. 73. 1. Collected at Holyhead.

## Order V.—ECHINONEMATA.

### Family.—Ectyonida.

*Dictyocylindrus stuposus*, Bk.

This is a *Dictyocylindrus* with a stellate flesh spicule, and is most probably the *Raspalia stelligera* of Schmidt. Mr. Carter has lately broken up his group Pluriformia into three divisions, the last of which is Dictyocylindrina, to receive sponges of this type. The appearance of the stellate spicule in this species‡ is a noticeable feature, probably evidencing a relationship to some species in the next order, Holorhaphidota.

L. M. B. C., No. 85. 3. Collected at Port Erin, Isle of Man.

L. F. M., No. 29. 10. 73. 1. Collected at Holyhead.

* See fig. 262, pl. xiii, vol. i, Bowerbank's *Mon. Brit. Spong.*; Johnston's *Brit. Spong.*, fig. 94, pl. iii; *Mon. Brit. Spong.*, vol. iii, pl. lxvi; Esper., 1794, taf. xxxvi; *Annals and Mag. Nat. Hist.*, October, 1885.

† See *Mon. Brit. Sponges*, vol. ii, p. 373; vol. iii, pl. lxvii.

‡ *Mon. Brit. Spon.*, vol. iii, pl. xix, figs. 1–7; *Spongienf. Atlan.*, p. 60, taf. 5, fig. 14.

*Plumohalichondria plumosa*, C.

*Hymeniacidon plumosa*, Bk. = *Microciona plumosa*, Bk.
*Halichondria plumosa*, J.

This species, as well as *Ophlitaspongia seriata*, represents, with a few other species, the British examples of Mr. Carter's order Echinonemata, which embraces all sponges whose fibre is echinated with spicules.*

L. F. M., No. 32. 3. 73. 2. Collected at Holyhead.

*Ophlitaspongia seriata*, Bk.

*Chalina seriata*, Bk. = *Halichondria seriata*, J.

This species † is plentiful at Holyhead, surrounding in a layer about a quarter of an inch thick, the stems of *Laminaria*.

L. F. M., No. 25. 9. 73. 12. Collected at Holyhead.

## Order VI.—HOLORHAPHIDOTA.

### Family.—Renierida.

### Group.—Amorphosa.

*Amorphina panicea*, S.

*Halichondria panicea*, J.

This is a species ‡ without any fibrous skeletal structure, the spicules, which are simple acerate, being dispersed throughout the sponge substance, and loosely congregated together in support of the areolar mass, which, when cut through, has the appearance of a slice of bread (bread-

* For illustrations of this kind of fibre see figs. 287, 288, 289, 290 and 291, pl. xvii, *Mon. Brit. Spong.*, vol. i. For illustration of the fibre of this species, see fig. 13, pl. xxiv, vol. iii.

† For illustration of the fibre of this species, see fig. 287, pl. xvii, vol. i, *Mon. Brit. Spong.* For figure of sponge coating a piece of rock, see pl. lxv, vol. iii.

‡ For good illustrations of the usual forms of this sponge, see pl. xl, vol. iii, *Mon. Brit. Spong.* Johnston's *Brit. Spong.*, p. 114, pl. xxxi; *Mon. Brit. Spong.*, vol. i, pl. xix, fig. 300; vol. ii, p. 229; vol. iii, pl. xxxix and xl.

crumb). Sponges of this character come under Schmidt's genus *Amorphina*, and into Mr. Carter's group Amorphosa. Amorphosa is the first group in Mr. Carter's Order VI, which embraces the *Reniera* of Schmidt, the *Suberites* and the Pachytragida, or Corticata, as well as the Lithistina and *Spongilla*. It is a very large order, but the divisions of it are very marked, and easily distinguishable.

L. M. B. C., No. 85. 4. Collected at Hilbre Island, and also at Port Erin, Isle of Man.

L. F. M., No. 24. 5. 73, 4. From the Egremont shore and Holyhead.

*Amorphina coccinea*, S.

*Hymeniacidon coccinea*, Bk.

This species is, as its name implies, a scarlet coloured sponge, and having acerate spicules, I have placed it in the group Amorphosa. It is a sessile species. The specimen in the L. F. M. Collection is mentioned by Dr. Bowerbank in his third volume, page 353.

L. F. M., No. 24. 5. 73, 16. Collected in Belfast Lough. V.

*Amorphina albescens*, S.

*Hymeniacidon albescens*, Bk.

This is a sessile species, which puts out usually one, but sometimes more than one, branch, about a couple of inches in length, with a diameter of a quarter of an inch or less. It is yellow when living, but in the dried state is greyish white. Its spicules, like those of the preceding species, are acerate.

L. F. M., No. 22. 4. 9. 74, 5. Holyhead. V.

*Amorphina caruncula*, S.

*Hymeniacidon caruncula*, Bk.

Dr. Bowerbank makes this species to differ from its very near relative *Hymeniacidon sanguinea* in colour, and in the size of its spicules. In the living state it is "light to deep

orange," whilst the other is "blood red;" and its spicules are rather stout acuates, whilst those of *H. sanguinea* are of the same form but longer.

L. M. B. C., No. 85. 5. Collected in shore pools at Kitterland, near Port Erin, Isle of Man.

L. F. M., No. 32. 3. 73, 1. Collected at Holyhead. V.

### Group Isodictyosa.

*Isodictya varians*, Bk.

This sponge, belonging to the group Isodictyosa, rather resembles *Chalina oculata* in appearance—compare plates lxvi and lxxxviii in Dr. Bowerbank's third volume—but it differs greatly under the microscope. The skeleton of *C. oculata* is a horny fibre cored with spicules, whilst that of *I. varians* is a structure made up of spicules merely held together, where they touch each other, with horny matter; the spicules are simply cemented together thus, and are not enclosed in horny fibre. This difference distinguishes the Chalinas from the Isodictyas, and these species, which resemble each other so much in form, are good examples of the two groups. The orders Rhaphidonemata and Holorhaphidota run together in *Isodictya,* and perhaps the group of Isodictyosa might without disadvantage be taken out of the latter order and placed in the same order with Chalinida. Dr. Bowerbank's plate lxxxviii in his third volume is from a specimen in the Liverpool Free Museum, one of a large number taken at low water near the old ferry slip at Egremont by myself, in company with Mr. T. J. Moore, in 1869. It was found flourishing in the bed of a stream of warm *fresh* water running from the engine-house connected with the slip. The fact that this marine species was found in brackish water growing luxuriantly within the influence of a fresh water stream, becomes of great interest when considered in relation to a fresh-

water sponge found in very deep pools in a South American river, more than two hundred miles from the sea (river Uruguay),* together with some others of like form from deep parts of an inland lake (Lake Baikal).† Dr. Bowerbank described this Uruguay species in his "Monograph of the Spongillidæ" (*Proc. Zool. Soc.*, Nov., 24, 1868), under the name *Spongilla coralloides*, but Mr. Carter (*Annals and Mag. Nat. Hist.*, Feby. 1881), created a new genus for it, *Uruguaya*, and grouped it with the other sponges of similar growth just alluded to, *Lubomirskia baicalensis*, and its varieties.

*Isodictya varians*, until the discovery of the sponge in the Mersey, was only known by "a small fragment surrounding two adjoining branches of a small *Fucus*, forming two parallel and united cylinders of sponge, an inch in length, and seven lines in width, and varying in thickness from one to two lines, sent to Dr. Johnston by Mr. Barlee, from Shetland." Whether this fragment was brought up by the dredge or was picked up on the shore does not appear. It is, however, clear that it is not common on our coasts as a marine species, whilst the great profusion in which it was found at Egremont under the circumstances already stated (for the bed of the stream was thickly covered with it), indicates that the conditions of life there were most favourable for its growth and development. It thus appears to form a link between marine and fresh water sponges. Marine sponges reproduce by means of ova and spermatozoa, and fresh water sponges can also reproduce in this way, as was shown by Lieberkühn in 1856 (*Beiträge zur Entwickelungsgechichte der Spongillen, Archiv f. Anat. u. Physiologie*, Heft i, u. ii, pp. 1–19, January), but all fresh water sponges, with

* *Proc. Lit. and Phil. Soc. Liverpool*, 1877–8, vol. 32, p. lvi—"On a fresh-water Sponge from Bahia," T. Higgin, F.L.S.

† *Annals and Mag. Nat. Hist.*, Feby., 1881, and July, 1884.

the exception of the one from the river Uruguay and those from Lake Baikal, have been proved to reproduce in addition by means of a seed-like body or "statoblast." The method of reproduction in the case of *Uruguaya coralloides*, and of *Lubomirskia baicalensis* with its varieties and allies, is not known, but the most diligent search by various observers has not resulted in finding the statoblast in any examples of the different species. In this respect, for the present, these fresh water species stand apart from the rest of the Spongillidæ which are classified according to the spicules of the statoblast, the body spicules of the various species not being sufficiently different from each other for the purpose. *Isodictya varians* * in its form bears a very strong resemblance to *Uruguaya coralloides* and to *Lubomirskia baicalensis*, and it also contains in quantity in its spiculation the curved cylindrical form of spicule common to them. The points of resemblance, or, it may be, of relationship, therefore, between these marine and fresh water species seem well worth recording.

L. M. B. C., No. 85. 6. Collected at Hilbre Island.

L. F. M., No. 32. 12. 69. 40. Type specimen. Collected on the Mersey shore, at Egremont, in 1869.

*Isodictya elegans*, Bk.

Dr. Bowerbank figures three fragments, as type specimens of this species.† Professor Herdman obtained one specimen at Port Erin, of reptant growth; but in a shore pool where the sponge was protected and could grow freely, he obtained two nice complete specimens of erect growth, tubular and branched. The colour of these when taken was lilac pink, a colour which is seen in some species of *Chalina*, and which, coupled with other characters common to both, may be regarded as indicating a relationship between

* *Mon. Brit. Spong.*, vol i, pl. xx, fig. 309; for skeletal network of spicules, vol. ii., p. 281; vol. iii., pls. xlviii and lxxxviii.

† *Mon. Brit. Spong.*, vol. ii, p. 283, and vol. iii, pl. xlix, figs. 1–5.

the genera *Isodictya* and *Chalina.* Professor Herdman's specimens abound with ova in an advanced state of duplicate sub-division, and ciliated embryos. They were obtained in July and August.

L. M. B. C., No. 85. 7. In shore pool, Port Erin, Isle of Man; also dredged near Port Erin.

*Isodictya simulans*, Bk.*

This is a compact form of *Isodictya* of pretty well marked character, and, therefore, is more easily recognised than many species of the genus. Its spicules are short, rather stout, acerates. It is usually found of a branching growth, but it is polymorphous.

L. F. M., No. 24. 5. 73, 16. Collected at Douglas Bay. V.

*Isodictya pallida*, Bk. †

The colour of this sponge is pale grey, or cream. Its spicules are stout and very slender acerates. It is of massive coating growth, and is not difficult to recognise.

L. F. M., No. 24. 5. 73. 7. Collected at Douglas Bay. V.

*Isodictya densa*, Bk. ‡

This is a massive spreading growth with stout acerate spicules.

L. F. M., No. 24. 9. 73, 2. Collected at Holyhead. V.

L. M. B. C., No. 85. 19. Collected at Port Erin.

*Isodictya fistulosa*, Bk. §

This is a massive form throwing up thin-walled tubes or fistulæ. Its colour alive is white, with a pinkish tint. Its spicules are two kinds of acerates, the one fairly stout and the other very slender.

L. F. M., No. 4. 9. 74, 10. Collected at Holyhead. V.

* *Mon. Brit. Spong.*, vol. ii., p. 308; vol. iii, pl. 51.

† *Op. cit.*, vol. ii, p. 297; vol. iii, pl. 50.

‡ *Op. cit.*, vol. ii, p. 292; vol. iii, pl. 50.

§ *Op. cit.*, vol. ii, p. 299; vol. iii, pl. 58.

*Isodictya clava*, Bk. *

The examples collected at Douglas Bay were long slender stems, about a couple of inches long, with a diameter of a line or less, sometimes branched; the specimens figured by Dr. Bowerbank have the appearance of immature forms. The spicules are rather short stout acerates.

L. F. M., No. 2. 5. 9. 73, 8. Douglas Bay. V.

*Isodictya fucorum*, Bk. †

This is a pink or red coloured sponge, of amorphous growth, with acerate spicules and an equianchorate flesh spicule.

L. F. M., No. 24. 5. 73, 12. Douglas Bay. V.

## Group Halichondrina.

*Halichondria incrustans*, Johnston.

In the preceding species of the orders IV, V, and VI, which produce spicules, we have been dealing generally with sponges having simple acerate or acuate spicules, but in *H. incrustans* ‡ we have a species supplied abundantly with flesh spicules, in addition to the spicules of the skeleton which consist of smooth or spined acuates and curved or straight cylindrical forms, sometimes inflated at the ends, sometimes pointed and microspined near the ends. The flesh spicules are C-shaped, bihamate and equianchorate. Mr. Carter has made this sponge representative of the group Halichondrina. It is of wide distribution, having been found in the West Indies, the Falkland Islands, and in other parts of the world. In one example, the spined acuate is

* *Mon. Brit. Spong.*, vol. ii, p. 316; vol. iii, pl. 53.

† *Op. cit.*, vol. ii, p. 322; vol. iii, pl. 56.

‡ See *Johnston's Brit. Spong.*, p. 122, pl. xii, fig. 3; *Mon. Brit. Spong.*, vol. ii, p. 249, and vol. iii, pl. xliv, fig. 7-12.

found echinating the skeleton fibre, thus bringing this variety into Mr. Carter's order Echinonemata.

L. M. B. C., No. 85. 8. Collected at Port Erin, Isle of Man.

L. F. M., No. 4. 9. 74, 5. Collected at Holyhead.

*Esperia œgagropila*, C.

*Desmacidon œgagropila*, Bk.
*Halichondria œgagropila*, Bk.

This species* is also the British representative of a large group of wide distribution, the genus *Esperia* of Nardo. The skeleton spicule is a sub-pin-like form, the inflated end of which is usually of less diameter than the shaft, and the flesh spicules are bihamate, tricurvate, and inequianchorate. A characteristic feature of the genus is a beautiful polygonal lace-like dermal reticulation covering the surface, by which examples are readily recognised.

L. F. M., No. 18. 10. 73. 4. Collected at Holyhead.

Family.—SUBERITIDA.

*Cliona celata*, J.

*Raphyrus griffithsia*, Bowerbank.

Johnston described two varieties of this sponge, one "massive," the other "sinuous." The massive variety Dr. Bowerbank made a new genus for, and named it *Raphyrus griffithsia*; the sinuous variety, that found boring into shells, he placed in his genus *Hymeniacidon*, as *Hymeniacidon celata*. Mr. Carter has found Johnston's view more correct than that of Bowerbank, and asserts that the sinuous form becómes the massive form. In support of this view, from a large number of examples of this sponge (which is

* Johnston's *Brit. Spong.*, p. 119, pl. xi, fig. 1; *Mon. Brit. Spong.*, vol. ii, p. 352; vol. iii, pl. lxiii, figs. 8–14; pl. lxxxiii, fig. 23. *Spongienf. Atlan.*, Schmidt, 1852, pp. 53–57, pl. v, figs. 2–8, 14.

very abundant all around our coast), it is said that one may select gradations of every variety of form, from the shell bored with small circular holes, through various stages during which the shell becomes more and more perforated and the sponge grows over it, surrounds it and encloses it, until it reaches the massive free form christened by Dr. Bowerbank *Raphyrus griffithsia.* On the other hand, however, Schmidt makes *Raphyrus griffithsia* equal to his *Papillina suberea.*

This species* belongs to the large family Suberitida, which embraces another sponge (*Suberites suberea,* see below) common on our coasts surrounding shells of various sizes, and in fact, in some instances, converting the shell into sponge substance, whilst to some extent the form of the shell is retained. The characteristic form of spicule is "pin-like." The well-known "Neptune's Cup" sponge *Raphiophora patera* (Gray), also belongs to this group.

L. M. B. C., No. 85. 9. Collected at Port Erin.

L. F. M., No. 9. 2. 75. 6. Collected at Holyhead.

*Suberites suberea,* S.

*Hymeniacidon suberea,* Bk.

*Halichondria suberea,* J.

This is the species† alluded to in the notes on *Cliona celata* as surrounding shells. It is the *Suberites domuncula* of Schmidt, and is representative of the compact forms (group Compacta) of the family.

L. F. M., No. 15. 6. 62. Collected at Holyhead, Liverpool Bay, and Morecambe Bay.

*Suberites carnosa,* S.

*Hymeniacidon carnosa,* Bk.

*Halichondria carnosa,* J.

This is another Suberite of compact form. The spicules

* Johnston's *Brit. Sponges*, p. 125; *Mon. Brit. Spong.* vol. ii, p. 212; vol. iii, pl. xxxviii, and pl. lxiv; *Spongf. Atlan.*, p. 65.

† Johnston's *Brit. Spong.*, pp. 139–141, pl. xii, figs. 5, 6; *Mon. Brit. Spong*, vol. ii, p. 200; vol. iii, pl. xxxvi, figs. 1–4; *Spongf. Atlan.*, p. 67.

are very similar to those of *S. suberea*, but the growth of the sponge is different, and the surface is more hispid.*

L. M. B. C., No. 85. 10. Collected at Hilbre Island.

*Hymeniacidon sanguinea*, Bk.
*Halichondria sanguinea*, J.

This species† Schmidt places in his genus *Amorphina*, but Mr. Carter places it in the family Suberitida, though the spicules are acuate and not pin-like, with the remark that Bowerbank found on Johnston's type specimen in the the British Museum, No. 47. 9. 7. 19, flesh spicules (which, however, he does not appear to have regarded as belonging to the specimen) like those of *Vioa johnstonii*, Schmidt, a Suberite. Mr. Carter has placed it in his group Laxa, which also contains *Vioa johnstonii*.

L. M. B. C., No. 85. 11. Collected in tidal pools near Port Erin.

L. F. M., No. 24. 5. 73. 10. Collected at Holyhead and Douglas Bay. V.

Family.—PACHYTRAGIDA.

*Pachymatisma johnstonia*, Bk.

This sponge belongs to a family quite different from any previously considered in these notes. It has a crustular surface,‡ and is embraced in Mr. Carter's family Pachytragida, which also contains the genera *Geodia* (Lamarck), *Tethya* (Johnston), and *Stelletta* (Schmidt). It corresponds with Schmidt's group Corticatæ. The pachytragous sponges possess the various forms of four rayed spicules (quadrira-

* See Johnston's *Brit. Spon.*; *Mon. Brit. Spong.*, vol. ii, p. 203; vol. iii, pl. xxxvi.

† Johnston's *Brit. Spong.*, p. 133, pl. xiv, fig. 3; *Mon. Brit. Spon.*, vol. i, p. 239, pl. iii, fig. 72; vol. ii, p. 168; vol. iii, pl. xxxii, fig. 5–8.

‡ See *Mon. Brit. Spong.*, vol. i, pl. xxvii, fig. 353; vol. ii, p. 51; vol. iii, pl. viii, figs. 1–7. *Annals*, 1869, vol. iv, p. 8, pl. ii, figs. 7, etc.

diate). The crust in the genus *Geodia* consists of globular or ellipsoidal siliceous bodies closely packed together, upheld by the short arms of the four rayed spicules. The species of *Stelletta* have no globular siliceous bodies on the surface, but have a thick dermal layer of cells charged with the stellates of the species, whilst the surface of the genus *Tethya* is hirsute with tufts of spicules projecting through the dermal layer.

L. F. M., No. 4. 9. 74, 2 (spirit). Collected at Holyhead.

*Stelletta grubii*, Schmidt.

This species is described by Schmidt in his Atlantic Sponges,* and has also been found by Mr. Carter at Budleigh Salterton.

L. F. M., No. 4. 9. 74, 6. Collected at Holyhead.

*Ecionema ponderosa*, Bk.

This is no doubt the same sponge which Mr. Carter described in 1871 as *Stelletta aspera*. It is undoubtedly a species allied to *Stelletta*. †

L. F. M., No. 4. 9. 74, 3. Collected at Holyhead.

### Family.—PACHASTRELLIDA.

*Dercitus niger*, C.

*Hymeniacidon bucklandi*, Bk.
*Battersbyia bucklandi*, Bk.

Before issuing his third volume in 1874, Dr. Bowerbank removed this sponge from his genus *Hymeniacidon* and created a new genus for it, *Battersbyia*, and gave a section of it in one of his illustrations. It had been, however, more particularly described and figured by Mr. Carter in 1871 as

* *Spongf. Atlan.*, 1862, p. 46, pl. iv, fig. 2.

† *Mon. Brit. Spong.*, vol. ii, p. 56, and vol. iii, pl. viii, fig. 8–15; *Annals and Mag. Nat. Hist.*, 1871, vol. vii, p. 7, pl. iv, fig. 7, etc.

*Dercitus niger.** This is the sponge which Dr. Bowerbank likened in appearance to a piece of bullock's liver.

Mr. Carter has included it in his family Pachastrellida, which embraces Schmidt's genus *Pachastrella*, and the Lithistid, or stony sponges.

L. F. M., No. 4. 9. 74, 4. Collected at Holyhead.

## Order VIII.—CALCAREA.

The only monograph of the Calcarea or sponges which have calcareous spicules is that published by Professor Haeckel† in 1872. Previous and subsequent writers have described a few species only, but Haeckel had a large number before him. There has been a general concurrence in his classification, though exceptions have been taken to some of his views and speculations. The Calcarea of the "Challenger" Expedition were examined and reported upon by Dr. N. Polejaeff,‡ of the University of Odessa, a distinguished pupil of Professor F. E. Schultze; and, at the present moment, Mr. H. J. Carter, F.R.S., of Budleigh Salterton, has under examination a very large collection from Australian waters. Dr. Polejaeff had only a few species to report upon.

Professor Haeckel divided the whole order into three families, Ascones, Leucones, and Sycones, according to the canal system, and these again into groups and genera, according to the prevailing forms of spicules. "The Ascones present the simplest form of the canal system. The thin wall of the sponge consists of three parallel layers, ectoderm, mesoderm, and endoderm. Here and there the cells separate, and thus give origin to the pores" (Vosmaer.) The

* *Mon. Brit. Spong.* vol. ii, p. 226; vol. iii, pl. xxxviii, fig. 9-12, and pl. xcii, fig. 8, p. 346. *Annals and Mag. Nat. Hist.*, 1871, vol. vii, p. 8, pl. iv, fig. 1, etc. *Proc. Zool. Soc.*, 1867, p. 542.

† *Die Kalkschwämme*, Haeckel, 1872.

‡ *Report on the Calcarea*, by Dr. N. Polejaeff, M.A., Zool. Chall. Exp., part xxiv, 1883.

Leucones are those with branched canals, and the Sycones those with a radial canal system. Polejaeff does not agree with Haeckel's distinction of Leucones from Sycones, but proposes to group the Ascones in one order, Homocœla, and both the others in another order, Heterocœla, treating the Calcarea as a separate CLASS.

The Calcarea found on our coasts are usually very small. I have never found an example of *Sycandra compressa* more than one-and-a-half inches in length, but Dr. Bowerbank speaks of one from Ipswich River five inches long by three-and-a-quarter broad. *Sycandra ciliata* is generally a quarter to half an inch in length, but Ipswich River produced one for Dr. Bowerbank three inches long by three-quarters of an inch in diameter. The size evidently depends on the locality being favourable for growth or otherwise.

Family.—ASCONES.

*Ascaltis botryoides*, H.

*Leucosolenia botryoides*, Bk.
*Grantia botryoides*, Fleming and Johnston.

The specific name is descriptive of the way in which a number of individuals of the species are found congregated together in branches or tufts.* Colour white.

L. F. M., No. 25. 9. 73. 3. Collected at Holyhead.

*Ascetta coriacea*, H.

*Leucosolenia coriacea*, Bk.
*Grantia coriacea*, Fleming and Johnston.

This is a pretty encrusting species.† Colour greyish white or dark crimson, or lemon yellow or nut brown.

* *Mon. Brit. Spong.*, vol. ii, p. 28; vol. iii, pl. iii, figs. 1–4. *Die Kalkschwämme*, vol. ii, p. 65; vol. iii, taf. 9, fig. 10.

† *Mon. Brit. Spong.*, vol. ii, p. 34; vol. iii, pl. iii, fig. 11–14. *Die Kalkschwämme*, vol. ii, p. 24; vol. iii, taf. 8.

L. M. B. C., No. 85. 12. Collected at Port Erin, Isle of Man. L. F. M., No. 22. 4. 74. 6. Collected at Holyhead.

Family.—Leucones.

*Leucandra gossei*, H.

*Leucogypsia gossei*, Bk.

This is a massive sessile species.*

It is readily recognised by the large acerate spicules lying longitudinally on its surface. Colour white.

L. M. B. C., No. 85. 13. Collected at Port Erin, Isle of Man.

L. F. M., No. 22. 4. 74. 8. Collected at Holyhead.

*Leucandra nivea*, H.

*Leuconia nivea*, Bk.

*Grantia nivea*, Fleming and Johnston.

Coating smooth or lobular.† Colour white.

L. M. B. C., No. 85. 14. Collected at Port Erin, Isle of Man.

L. F. M., No. 25. 9. 73. 4. Collected at Douglas Bay.

*Leucandra johnstonii*, H.

*Leuconia johnstonii*, C.

Mr Carter says, a good feature for recognising the species is the large four-rayed surface spicule with a dark centre, the dark centre being the fourth ray, or shaft, penetrating the sponge substance.‡ Colour white.

L. M. B. C., No. 85. 15. Collected at Port Erin, Isle of Man.

L. F. M., No. 26. 8. 82. 1. Collected at Holyhead.

* *Mon. Brit. Spong.*, vol. ii, p. 42; vol. iii. *Die Kalkschwämme*, vol. ii, p. 177; vol. iii, taf. 37.

† *Mon. Brit. Spong.*, vol. ii, p. 36; vol. iii, pl. v, fig. 1-8. *Die Kalkschwämme*, vol. ii, p. 211; vol. iii, taf. 39.

‡ *Annals and Mag. Nat. Hist.*, 1871, ser. iv, vol. viii, p. 3, pl. i, figs. 5-12. *Die Kalkschwämme*, Haeckel, vol. ii, p. 216, pl. 34.

*Leucandra fistulosa*, H. *

*Grantia fistulosa*, J.

*Leuconia fistulosa*, Bk.

L. M. B. C., No. 85. 16. Collected at Port Erin, Isle of Man.

Family.—SYCONES.

*Sycandra compressa*, H.

*Grantia compressa*, Fleming.

This is a very easily recognised species from its hollow compressed form; it is found in quantity all round our coasts attached to seaweed. It is well figured both by Haeckel and Bowerbank.†

L. M. B. C., No. 85.17. Collected at Port Erin, Isle of Man.

L. F. M., No. 22. 4. 74. 2. Collected at Holyhead.

*Sycandra ciliata*, H.‡

*Grantia ciliata*, H.

L. M. B. C., No. 85. 18. Collected at Port Erin, Isle of Man.

L. F. M., No. 22. 4. 74. 4. Collected at Holyhead.

## DESCRIPTION OF A NEW SPECIES BY H. J. CARTER, F.R.S.

*Aphroceras ramosa*, n.sp.

Small, cylindrical, branched, sessile; branchlets more or less acuminated, horn-shaped; without peristome. Colour whitish-yellow. Surface even, consisting of long, large, fusiform acerates arranged parallel to each other and closely

* *Mon. Brit. Spong.*, vol. ii, p. 89; vol. iii, pl. v, figs. 9–16. *Die Kalkschwämme*, Haeckel, vol. ii, p. 197; vol. iii, pl. 31.

† *Mon. Brit. Spong.*, vol. ii, p. 17; vol. iii, pl. i. *Die Kalkschwämme*, vol. ii, p. 360; vol. iii, taf. 57.

‡ *Mon. Brit. Spong.*, vol. ii, p. 19; vol. iii, pl. ii, figs. 1–15. *Die Kalkschwämme*, vol. ii, p. 296; vol. iii, taf. 58, fig. 9.

approximated, on the same plane, more or less covered by small sagittiform triradiates. Pores situated in the interstices between the arms of the triradiates, along the intervals of the large acerates. Vent single, at the end of each branch, naked, *i.e.*, without peristome; leading into a cylindrical, cloacal cavity, about the same shape as the sponge, and equally branched; presenting on its surface a great number of circular holes in juxtaposition, rendered more or less polygonal by the intercrossing of the rays of the radiates that form the skeletal structure of the cloaca, which is sparsely echinated by the fourth ray of the quadriradiates. Wall consisting of simple, cancellated sarcode, traversed horizontally, at intervals, by the shafts of large, sagittiform triradiates which, coming from opposite sides and overlapping each other, have their heads in the internal surface of the cortex and that of the cloaca respectively.

Spicules of three kinds, viz., acerate, triradiate, and quadriradiate. 1st, acerate, very large, long, fusiform, slightly curved, and often lance-pointed anteriorly, averaging $\frac{1}{5}$th inch long by $\frac{1}{357}$th inch in its greatest transverse diameter; 2nd, triradiates, small and large, the latter averaging $\frac{18}{1800}$ by $\frac{1}{1800}$th inch in the shaft, and the arms respectively $\frac{2}{3}$rds of this size; 3rd, quadriradiates, of the same size as the large triradiates, with the addition of the fourth arm which is short and curved, about $\frac{3}{1800}$ths inch long. No. 1 is confined to the surface with the arrangement before stated; No. 2 in its larger form, to the wall, also as above stated; and the smallest, which are chiefly sagittiform, to the outer and inner surfaces; No. 3 to the inner part of the cloaca, where they are formed by the addition of the fourth arm to the heads of the large triradiates of the wall which abut against this part; thence projecting into the cavity of the cloaca. Size of specimen, which is much broken, under $\frac{1}{12}$th inch in the diameter of the stem; length unknown; longest

fragment $\frac{8}{10}$ths of an inch; thickness of the wall, including the cortex and the cloaca, about $\frac{1}{8}$th inch.

L. F. M., No. 22. 4. 74. 7. Collected at Holyhead.

This species in spiculation is very much like *Leucogypsia gossei*, Bowerbank, who, when he made a genus of it under the name of "*Leucogypsia*" in 1862 (*Phil. Trans.*, p. 1095), stated that he had not seen another species in Great Britain. In 1858, Dr. J. E. Gray described and illustrated a cylindrical branched species from Hong Kong, to which he gave the name of *Aphroceras alcicornis* (*Proc. Zool. Soc.*, Lond., p. 114, pl. x, figs. 1 and 2), and in 1867 (*Ib.*, p. 558) he made a family for it under the name of "Aphrocerasidæ." This species is closely allied in form to that discovered by Mr. Higgin, but differs greatly in structure; while the structure of *A. alcicornis* is almost identical with that of *Leucogypsia gossei*, hence Haeckel has placed them among his Leucones; but the structure of *Aphroceras ramosa* is Syconid, and belongs to a genus which I have named "*Heteropia*" in my forthcoming description of the Calcareous Sponges from the neighbourhood of Port Phillip Heads, S. Australia, sent to me by Mr. Bracebridge Wilson; meanwhile, Haeckel's illustration of the "Radial-tuben," in his *Sycilla cylindrus*, represents it well (*Die Kalkschwämme*, Atlas, taf. 43, fig. 6).

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NOTE.—A species of *Sycandra*, probably new to science, was also dredged near Port Erin, Isle of Man. It has been examined by Mr. Harvey Gibson, and his description and figures will be found further on in this volume.—Ed.

# REPORT on the HYDROIDA of the L. M. B. C. DISTRICT.

By Mr. W. R. Melly, J. Sibley Hicks, L.R.C.P., F.L.S., and Prof. Herdman, D.Sc.

A few words of explanation are necessary in regard to the joint authorship of this Report. Before the Liverpool Marine Biology Committee commenced their investigations, Dr. Sibley Hicks had done a good deal of work at the Hydroid Zoophytes of this neighbourhood, and had drawn up a list of thirty-eight species found in the estuary of the Mersey. This list was exhibited before the Literary and Philosophical Society of Liverpool, in 1880, but has not been published. As Dr. Hicks found that he could not spare sufficient time to undertake the Report upon the Hydroida, he handed over his list of species to the Committee, and has also given some assistance in identifying the specimens.

Mr. W. R. Melly, while working as a student in the Zoological Laboratory of University College, paid special attention to the Hydroids, and on the dredging expeditions which he took part in, he assisted me in collecting and preserving the smaller species of Zoophytes. Consequently, when it was found that Dr. Hicks could not undertake the preparation of this Report, I handed the collections over to Mr. Melly for examination. The work has been carried on during the present Winter Session in the Laboratory, under my direction. The greater part of the labour of preparing the Report has, then, been performed by Mr. Melly. He has examined and identified every specimen in the collection, and has drawn up the list of species, with records of their previous occurrence in the locality. My share of the work has been

confined to a general supervision of Mr. Melly's investigations, and some assistance in identifying the more difficult species.

W. A. Herdman.

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The Hydroida are well represented in the neighbourhood of Liverpool, and are especially abundant on the shores of Hilbre Island. Former investigators in this locality have paid more attention to the Zoophytes than to most other groups of animals, and consequently there are comparatively few species to add to the existing lists as the result of the Committee's dredging investigations. Mr. Byerley, in his *Fauna*, published in 1855, records thirty-three species, of which twenty-six have been found by members of the Committee during 1885; fifteen of the species previously recorded from this neighbourhood have not been found during 1885. Dr. Sibley Hicks records thirty-eight species, including six not mentioned by Byerley, in his list drawn up in 1880. A few localities within the L. M. B. C. District have been given by Hincks, Allman, and Pennington in their works on the Hydroid Zoophytes. Mr. A. O. Walker, of Chester, has furnished us with records of the species which he has found in the neighbourhood.

The large collections made by the Liverpool Marine Biology Committee yielded forty-two species, eleven of which had not been previously recorded from this neighbourhood. Seven of the species were collected at Hilbre Island, sixteen were from various parts of Liverpool Bay, seven were obtained during the cruise of the "Hyæna," seven were obtained at Penmaenmawr by Mr. Thompson, and thirty were collected off the south end of the Isle of Man by Professor Herdman.

The classification and nomenclature of species given by Mr. Hincks * have been followed.

* *History of the British Hydroid Zoophytes*, van Voorst, London, 1868.

## Order.—HYDROIDA.

### Sub-order I.—ATHECATA.

#### Family I.—Clavidæ.

*Clava multicornis*, Forskal.

*Clava discreta*, Allman, *Ann. N. H.*, Nov., 1859.

Recorded by Byerley as having been found on floating *Fuci* by Mr. Price. Mersey (J. S. Hicks).

Found at Hilbre Island, May 17th, 1885, and June 18th, 1885, on the under surfaces of stones. The specimens found on May 17th had gonophores.

Some of these specimens, obtained at Hilbre Island, lived in the laboratory at University College in a small 1-oz. bottle of sea water for over six months. A few specimens were obtained at the south end of the Isle of Man adhering to *Corallina officinalis.*

*Clava leptostyla*, Agassiz.

Mentioned by Hincks as being found at Morecambe Bay. Also recorded by Allman from the same locality.

#### Family II.—Hydractiniidæ.

*Hydractinia echinata*, Fleming.

*Alcyonidium echinatum*, Johnston, *B. Z.* (1st. edit.) 304, pl. xiii, figs. 3, 4.

Recorded by Byerley. Mersey (J. S. Hicks).

Dredged at Hilbre Swash, June 20th, 1885, from a depth of ten fathoms; also dredged on the Constable Bank, near Llandudno, during the cruise of the "Hyæna," May 23rd, 1885. Found by Mr. Thompson at Penmaenmawr, and at Point of Ayr by Mr. A. O. Walker; in all cases on shells inhabited by Hermit Crabs.

#### Family V.—Corynidæ.

*Coryne* sp. (?).

A species of *Coryne* was found attached to masses of wood at the breakwater, near Port Erin, Isle of Man, in August,

1885. The specimens are not in the collection, and are recorded on the authority of Prof. Herdman, who examined them in a living condition.

*Coryne pusilla*, Gaertner.

Recorded by Byerley as being found on the Dingle rocks by Mr. Price. Mersey (J. S. Hicks). Hilbre Swash (A. O. Walker). Bangor (A. S. Pennington).

Found at Hilbre Island, June 13th, 1885. The specimens are not in the collection, but the species was identified and recorded at the time.

### Family IX.—Eudendriidæ.

*Eudendrium rameum*, Pallas.

> *Tubularia ramosa*, Johnst. *Trans. Newc. Soc.*, ii, 253, pl. x.
> *E. rameum*, Johnst. *B. Z.* (2nd edit.) 45, pl. v, figs. 1, 2, &c.

Recorded by Byerley. Mersey (J. S. Hicks). Mentioned by Hincks as being plentiful at Lytham. Recorded by Allman from Morecambe Bay.

*Eudendrium ramosum*, Linnæus.

Recorded by Byerley as having been found on Bootle shore by Mr. Marrat. Mersey (J. S. Hicks). Common in the district (A. O. Walker). Mentioned by Allman as being found at Morecambe Bay.

One large colony, growing on a stone, was dredged off the south end of the Isle of Man from a depth of ten to twenty fathoms, during August, 1885. This specimen resembles the figures given both by Hincks and by Allman, but it has no gonophores.

*Eudendrium capillare*, Alder.

> *Corymbogonium capillare*, Allman, *Ann. N. H.* for August, 1861, p. 168.

Found at Colwyn Bay in September, 1882, by Mr. A. O. Walker.

One colony, about 1½ inches in height, attached to the back of a specimen of *Hyas coarctatus*, and a second colony, about 2½ inches in height, were dredged off the south end of the Isle of Man, in August, 1885, from a depth of ten to twenty fathoms. Gonophores are present in both.

Neither Hincks nor Allman give any very good distinguishing characteristics by which *E. capillare* can be known from *E. ramosum*. The colonies of the former species seem to branch more irregularly, and, according to Allman, they develop gonophores between June and September, while in *E. ramosum* these are produced in April. The Manx specimens were obtained in August and have the gonophores well developed: they probably belong to *E. capillare*.

### Family X.—ATRACTYLIDÆ.

*Garveia nutans*, T. S. Wright.

*Eudendrium (Corythamnium) bacciferum*, Allman, "Notes on Hydroid Zoophytes," *Ann. N. H.*, July, 1859.

This rare Zoophyte was first found by Dr. Strethill Wright on the island of Inch Garvie, in the Firth of Forth, and almost simultaneously by Prof. Allman in the same locality (see Allman, *Gymnoblastic Hydroids*, p. 294). It has since been found in Shetland by Hincks, and at Morecambe Bay by Allman. It had not been previously found in Liverpool Bay, but last summer, during the expeditions of the Liverpool Marine Biology Committee, it was discovered in several localities, and seems to be fairly abundant now off the north end of Hilbre Island. It was found at low water on Hilbre Island on May 17th, with well developed gonophores; at the same locality, on June 13th; and was dredged in Hilbre Swash on May 9th, and again on June 20th, from depths of ten fathoms. It was also obtained during the cruise of the "Hyæna," on May 25th, off the Great Ormes

Head. It was found living at Colwyn Bay on drift stuff on April 19th, 1885, by Mr. A. O. Walker.*

*Bimeria vestita*, T. Strethill Wright.

This species is mentioned by Allman as having been found at Morecambe Bay.

*Bougainvillia muscus*, Allman.

Found at Colwyn Bay on April 27th, 1884, by Mr. A. O. Walker.

Family XI.—TUBULARIIDÆ.

*Tubularia indivisa*, Linnaeus.

Recorded as being very abundant by Byerley. Mersey (J. S. Hicks).

Dredged in the Welshman's Gut, June 20th. Found growing at Hilbre Island in large quantities, near low water mark. Dredged in Hilbre Swash on June 20th, depth ten fathoms. Dredged off the Great Ormes Head, from seven to eight fathoms, during the cruise of the "Hyæna," May 23rd, 1885.

*Tubularia coronata*, Abildgaard.

*Tubularia larynx*, var. β, Johnst., *B. Z.* (1st edit.) 116.

Mersey (J. S. Hicks). Mentioned by Hincks as being plentiful at Lytham.

Some dried stalks, which are probably those of *T. coronata*, were dredged in Welshman's Gut, on June 20th, from a depth of seven fathoms.

Collected at low water on Hilbre Island, on June 13th.

*Tubularia simplex*, Alder (?).

*Tubularia dumortierii*, Johnst., *B. Z.* 50.

A specimen which was dredged from deep water between Port St. Mary and the Calf, off Spanish Head, Isle of Man, on August 3rd, 1885, probably belongs to this species.

* *Garveia nutans* has also been recently found on Dalkey Island, Dublin Bay, by Prof. Haddon (see *Proc. R. I. Acad.*, ser. ii, v. iv, p. 524.)

*Tubularia larynx*, Ellis and Solander.

Recorded by Byerley as being very common round the coast. It has not been found during our investigations, and is not mentioned by Dr. Sibley Hicks. Possibly it may have been *T. coronata.*

*Tubularia britannica*, Pennington.

This species was found by Mr. Pennington in the Menai Straits.

*Ectopleura dumortierii*, Van Beneden.

*Tubularia dumortierii*, Johnst., *B. Z.* pl. vii, figs. 1, 2 (not the species described in the text).

Mentioned by Allman as being found at the Isle of Man, and recorded by Pennington from Point of Ayr.

*Corymorpha nutans*, Sars.

Mersey (J. S. Hicks). Isle of Man (Pennington).

## Sub-order II.—THECAPHORA.

### Family I.—Campanulariidæ.

*Clytia johnstoni*, Alder.

*Companularia volubilis*, Johnst., *B. Z.* 107, 108, woodcut fig. 18.
*Campanularia johnstonii*, Allman, *Proc. Roy. Soc. Ed.*, for Dec. 6th, 1858.

Hilbre Swash and Abergele Bay (A. O. Walker). Mersey (Hicks).

Several very large colonies were dredged during August, 1885, off the south end of the Isle of Man, in the neighbourhood of Port Erin. One well-developed colony was attached to the siphons of a specimen of *Molgula occulta.* Another colony, with gonothecæ, was found adhering to the stalk of a *Tubularia.* A third colony from the Isle of Man differed considerably from the typical condition. It was of much smaller size, and the calycles were much longer and

narrower than is shewn in Hincks' figure. It may be regarded as a small variety of the species.

Possibly this is the species mentioned by Byerley under the name of *Campanularia volubilis*.

*Obelia geniculata*, Linnaeus.

Recorded by Byerley under the name of *Laomedea geniculata*, as being very abundant upon Algæ, dead shells, &c. Mersey (J. S. Hicks).

*Obelia gelatinosa*, Pallas.

Recorded by Byerley under the name of *Laomedea gelatinosa*, as being common. Found in Hilbre Swash on July 2nd, 1872, by Mr. A. O. Walker. Liverpool (Collingwood). Menai Straits (Pennington).

This species is recorded by Hincks as being very common on the Dingle rocks, Egremont, Hilbre Island, and other places near Liverpool, in 1868. Mersey (J. S. Hicks).

One colony of this species, about 2½ inches in height, was obtained at the south end of the Isle of Man, August, 1885. This colony differs from Hincks' figure and description in having the margins of the hydrothecæ distinctly *not* denticulated. The hydrothecæ are very thin, and the edges are slightly ragged in some cases, but never denticulated. In all other respects the zoophyte agrees with Hincks' description.

*Obelia longissima*, Pallas.

*Laomedea dichotoma*, var. *β*, *B. Z.* p. 102.

Found off the Little Ormes Head on June 22nd, 1880, by Mr. A. O. Walker. Recorded from Blackpool by Pennington.

*Obelia flabellata*, Hincks.

*Campanularia flabellata*, Hincks, *Ann. N. H.* (3rd series), xviii, 297.

Not previously recorded from this neighbourhood.

This species was found at Hilbre Island on June 18th, 1885. Several colonies were also obtained from the Isle of Man, growing on the stalk of a *Tubularia*. Some of these specimens have gonothecæ.

A specimen, which was dredged off the Isle of Man in August, 1885, resembles Hincks' figure in most respects, but is a little less zigzag in its growth, though not so straight as *O. dichotoma*. Hincks figures three rings above each joint; our specimen has only one. Hincks does not mention the presence of tendrils in the species, while our specimen shews several. The hydrothecæ spring in some cases from the axils, a condition which Hincks mentions in his description of *Obelia dichotoma*, but not in the case of *O. flabellata*.

*Obelia dichotoma*, Linnaeus.

*Laomedea dichotoma*, var. *a*, Johnst., *B. Z.* 102, pl. xxvi, figs. 1, 2.

Recorded by Byerley under the name of *Laomedea dichotoma*, as growing in small tidal pools. Mersey (Hicks).

Several small colonies were obtained off the south end of the Isle of Man; no gonothecæ were present. One small colony, also without gonothecæ, was found at Penmaenmawr, by Mr. Thompson. One of the specimens showed tendrils like those figured by Hincks for *Campanularia angulata*.

A colony found at Hilbre Island on June 18th, is mentioned in the notes taken at the time, as being probably *O. dichotoma*, and is recorded as having had medusoid gonophores attached.

*Campanularia volubilis*, Linnaeus.

Recorded by Byerley as "Adhering to shells and Fuci in pools on the shores." Mersey (J. S. Hicks). Point of Ayr (A. O. Walker).

Several small colonies were dredged off the south end of

the Isle of Man during August. They were adhering both to the stalks of *Tubularia* and also to colonies of *Sertularia filicula*. None of these specimens had gonothecæ.

*Campanularia hincksii*, Alder.

*Campanularia volubilis*, var., Hincks, *Ann. N. H.* (2nd ser.) xi, p. 180.

Several colonies, attached to the stalks of *Tubularia*, were dredged off the south end of the Isle of Man, in August, 1885. They had gonothecæ.

*Campanularia caliculata*, Hincks.

Several small colonies of this species were obtained off the south end of the Isle of Man, from depths of ten to twenty fathoms, during August, 1885.

*Campanularia verticillata*, Linnaeus.

Recorded by Byerley as being very common. Mersey (J. S. Hicks). Common in the neighbourhood (A. O. Walker).

Two colonies, about 2½ inches in height, were dredged at Penmaenmawr in July, 1885, by Mr. Thompson.

One large colony, about 3 inches long, was dredged between Port St. Mary and the Calf, off Spanish Head, Isle of Man, in ten to twenty fathoms, August, 1885.

*Campanularia flexuosa*, Hincks.

*Laomedea gelatinosa*, Johnst., *B. Z.* 105, pl. xxv, figs. 3, 4.
*Laomedea flexuosa*, Hincks, *Devon and Cornw Cat.*, *Ann. N. H.* (3rd series), viii, 260. Allman, *Ann. N. H.* for May, 1864.

Mersey (J. S. Hicks). Mentioned by Hincks as being found at the Isle of Man. Point of Ayr (A. O. Walker).

Several colonies attached to sea-weeds and to the old stalks of *Tubularia*, were dredged at the south end of the Isle of Man in August, 1885. Some of them have gonothecæ.

*Campanularia angulata*, Hincks.

Recorded from the Menai Straits by Pennington.

A great many colonies attached to Algæ, were obtained at the south end of the Isle of Man, in August, 1885. The long claspers are present on several of the colonies.

Most of the specimens have the pedicels much shorter than those figured by Hincks. He describes the pedicels as consisting of nine to twelve rings, while those on most of our specimens have not more than six or seven. None of our specimens have gonothecæ.

*Campanularia neglecta*, Alder.

Found in Colwyn Bay on September 14th, 1878, by Mr. A. O. Walker.

Several colonies about $\frac{3}{10}$ inch in height were dredged at south end of Isle of Man in August, 1885. They are attached to a stalk of *Tubularia*, and have no gonothecæ.

*Gonothyræa lovéni*, Allman.

This species is not recorded by either Sibley Hicks or Byerley. It was found in Hilbre Swash on July 12th, 1878, by A. O. Walker; and has been recorded from the Menai Straits by Pennington.

Four colonies were dredged off the Isle of Man, in August, 1885. Two were attached to the stalk of a *Tubularia*, and the other two, about ¾-inch in height, were attached to Algæ.

Family II.—CAMPANULINIDÆ.

*Opercularella lacerata*, Johnston.

*Campanularia lacerata*, Johnston, *B. Z.* iii, pl. xxviii, fig. 3.
*Laomedea lacerata*, Hincks, *Ann. N. H.* (2 series), x, 86.
*Calycella lacerata*, Allman, *Ann. N. H.* for May, 1864, 31.

Mersey (J. S. Hicks). Mentioned also by Hincks as being found at the Isle of Man.

## Family IV.—Lafoëidæ.

*Lafoëa dumosa*, Fleming.

*Tubularia tubifera*, Johnston, *Edin. Phil. Jour.*, xiii, 222, pl. iii, figs. 2, 3.

*Calicella dumosa*, Hincks, *Cat. Devon and Cornw. Zooph.* 23; *Ann. N. H.* (3rd series), viii, 293.

Recorded by Byerley under the name of *Campanularia dumosa* as being common, parasitic upon Zoophytes, &c. Mersey (J. S. Hicks). Colwyn Bay (A. O. Walker).

Dredged in Hilbre Swash on June 20th, 1885.

Several colonies were dredged at the south end of the Isle of Man in August, 1885.

*Calycella syringa*, Linnæus.

*Campanularia syringa*, Johnston, *B. Z.* 110, woodcut 19.

Recorded by Byerley, under the name of *Campanularia syringa*, as being fairly common. Mersey (J. S. Hicks). Hilbre Swash (A. O. Walker).

Very common on stalks of *Tubularia* off south end of Isle of Man. Found in Hilbre Swash, June 20th, 1885, depth ten fathoms.

This species seems to some extent to have taken the place of the other Zoophytes of its family in this neighbourhood as it is commoner than *Lafoëa dumosa*.

*Filellum serpens*, Hassall.

*Reticularia serpens*, Hincks, *Ann. N. H.* (2nd ser.) xviii, 469 (1856).

Mersey (J. S. Hicks).

## Family VI.—Coppiniidæ.

*Coppinia arcta*, Dalyell.

This species has not been previously recorded from this neighbourhood.

It was dredged during the cruise of the "Hyæna," off the

Great Ormes Head, at a depth of seven to eight fathoms, on May 23rd, 1885, and was found at Colwyn Bay on June 18th, 1885, by Mr. Walker.

It was dredged from fifteen fathoms at the Isle of Man, off Port St. Mary, on August 3rd, 1885.

It has also been found cast ashore on the sands at West Kirby, opposite Hilbre Island.

Family VII.—HALECIIDÆ.

*Halecium halecinum*, Linnaeus.

Recorded by Byerley as abundant. Mersey (J. S. Hicks). Very common (A. O. Walker).

Dredged in Hilbre Swash on June 20th, from ten fathoms.

Two large colonies, one male and the other female, both with gonothecæ, were dredged at Penmaenmawr, July, 1885.

Five colonies, without gonothecæ, and one female and two male colonies, with gonothecæ, were dredged off Port Erin, Isle of Man, in August, 1885.

In one of the male specimens from the Isle of Man, the gonothecæ are *not* "borne in rows on the upper side of the pinnæ;" but are borne at the base of the calycles, as in *H. beanii*. But in the latter species there is no pedicel to the gonotheca; while in our specimen a short pedicel of about two rings is always present. In all other respects our specimens agree with Hincks' description of *H. halecinum*.

Hincks mentions in his Appendix a colony of *H. beanii* dredged off the Isle of Man, which presents a curious modification of the gonothecæ; probably our abnormal specimen is similarly only an unusual condition of *H. halecinum*.

*Halecium beanii*, Johnston.

*Thoa beanii*, Johnston, *B. Z.* (1st edit.) 120, pl. iii, figs. 1, 2.

Mr. Walker states that this species is not uncommon in the district, and he has also found the variety mentioned by Hincks in his Appendix (p. 324).

Two small colonies without gonothecæ, dredged off the Isle of Man in August, 1885, resemble *H. beanii* more nearly than any other species. The hydrothecæ are mostly single-jointed, but some have two joints. The polypites are large. One large colony, about three inches in height, with male gonothecæ, about which I think there is not much doubt, was also obtained off the south end of the Isle of Man, in August, 1885.

### Family VIII.—Sertulariidæ.

*Sertularella polyzonias*, Linnaeus.

Recorded by Byerley as not uncommon among drift seaweeds; seldom or ever found with living polypes. Mersey (J. S. Hicks). Little Orme, June, 1880 (A. O. Walker).

Several good colonies with gonothecæ were dredged off the south end of the Isle of Man, in August, 1885.

Dredged off Puffin Island and Anglesey, during the cruise of the "Hyæna" in May, 1885.

*Sertularella rugosa*, Linnaeus.

Recorded by Byerley as being parasitic on *Flustra foliacea*. Mersey (J. S. Hicks).

Found at Hilbre Island, attached to colonies of *Flustra foliacea*, on June 13th, 1885.

*Diphasia rosacea*, Linnaeus.

*Sertularia rosacea*, Johnst., *B. Z.* 64, pl. xi, fig. 1,; 468, fig. 83.

Recorded by Byerley under the name of *Sertularia rosacea*, as being found rarely at New Brighton and elsewhere, attached to *Plumularia falcata*. Mersey (J. S. Hicks). Found at Puffin Island in June, 1880 (A. O. Walker).

Several colonies were obtained from the Welshman's Gut during the "Spindrift" expedition, on June 20th, 1885.

A small colony, about half-an-inch in height, attached to the stalk of a *Tubularia*, along with some other zoophytes,

was dredged at the south end of the Isle of Man, in August, 1885.

*Diphasia attenuata*, Hincks.

*Sertularia rosacea*, Johnst., *B. Z.* 470.
*Sertularia pinaster*, var., Johnst, *B. Z.* 72, fig. C. D
*Sertularia attenuata*, Hincks, "On New British Hydroida," *Ann. N. H.*, October, 1866 (3rd series), xviii, 298.

Several large colonies of this species were dredged from Hilbre Swash on May 9th, 1885.

*Diphasia pinaster*, Ellis and Solander.

*Sertularia margareta*, Johnston, *B. Z.* 72, 73, fig. 13.

Mr. Byerley records this species under the name of *Sertularia margareta* as being found at the mouth of the Mersey by Mr. R. A. Tudor, and at New Brighton by Mr. Marrat. Mersey (J. S. Hicks).

*Diphasia tamarisca*, Linnæus.

*Sertularia tamarisca*, Johnston, *B. Z.*, pl xiii, figs. 2, 3, 4.

Recorded by Byerley under the name of *Sertularia tamarisca* as having been found on the Bootle coast by Mr. Tudor.

One small piece, about an inch in height, was dredged in Hilbre Swash, from ten fathoms, May 9th, 1885.

*Sertularia pumila*, Linnæus.

Recorded by Byerley as "having been found by Mr. Marrat between Seacombe and Egremont. Not common." Mersey (J. S. Hicks). Very common on *Fucus*, Colwyn Bay (A. O. Walker.)

One colony showing gonothecæ was dredged off the south end of the Isle of Man in August, 1885.

Found at Hilbre Island, on May 17th, with gonothecæ.

*Diphasia fallax*, Johnst.

*Sertularia fallax*, Johnst., *B. Z.* 2nd ed., p. 73.

Point of Ayr (A. O. Walker).

*Sertularia gracilis*, Hassall.

This species is recorded from Blackpool and from Bangor by Pennington.*

*Sertularia operculata*, Linnæus.

Recorded by Byerley as having been found without polyps by Mr. Marrat. Mersey (J. S. Hicks). Very common, dead (A. O. Walker).

A large number of colonies were obtained from Hilbre Swash on May 9th, 1885, and on June 20th; and also from the Welshman's Gut, on June 20th.

Dredged during the cruise of the "Hyæna" on May 25th near Puffin Island.

*Sertularia filicula*, Ellis and Solander.

Recorded by Byerley as being "a general but not a very abundant species." Mersey (J. S. Hicks).

Dredged in Hilbre Swash on June 20th, 1885, from a depth of ten fathoms.

Several small colonies were obtained from the Isle of Man. No gonothecæ were present.

*Sertularia abietina*, Linnaeus.

Recorded by Byerley as being common upon the coast. Mersey (J. S. Hicks). Common, dead (A. O. Walker).

One small colony was found at Penmaenmawr in July, 1885. Some large colonies were dredged off the south end of the Isle of Man in August, 1885. One of these colonies was much covered by specimens of *Crisia denticulata*. Dredged at Hilbre Swash on June 20th. Several large colonies were dredged from Welshman's Gut on June 20th. Dredged off the Great Ormes Head on May 23rd, during the cruise of the "Hyæna."

*Sertularia argentea*, Ellis and Solander.

Recorded by Byerley as being very common. Mersey

* *British Zoophytes*, 1885.

(J. S. Hicks). Very common (A. O. Walker). Menai Straits (Pennington).

Several *very* small pieces were obtained from the Isle of Man in August, 1885. A great many large colonies with gonothecæ were dredged from Hilbre Swash on May 9th, 1885. Also a large amount was dredged from Welshman's Gut on June 20th, 1885, with gonothecæ.

*Sertularia cupressina*, Linnaeus.

Recorded by Byerley as being not quite so common as *S. argentea*. Mersey (J. S. Hicks). Common (A. O. Walker).

Several large colonies were dredged from the Welshman's Gut, June 20th, 1885, with gonothecæ. Also large colonies were obtained in Hilbre Swash, on May 9th, 1885, with gonothecæ.

*Hydrallmania falcata*, Linnaeus.

Recorded by Byerley under the name of *Plumularia falcata*, as being frequent in pools at low water. Mersey (J. S. Hicks). Very common, dead (A. O. Walker).

One small colony was obtained from Penmaenmawr, in July, 1885. A young colony was dredged off Port St Mary, on August 3rd, 1885. A great number of very large colonies were dredged from Hilbre Swash, on May 9th and June 20th, 1885. Also large colonies, with gonothecæ, were found in Welshman's Gut, on June 20th, 1885. On all of these occasions, large masses were brought up in the dredge, along with other zoophytes. Also obtained attached to *Buccinum*, *Fusus*, and *Natica*, on May 23rd, during the cruise of the "Hyæna."

*Thuiaria articulata*, Pallas.

Recorded by Byerley as being found at Hilbre, New Brighton, and elsewhere. Mersey (J. S. Hicks).

This species has not been found during our investigations.

## Family IX.—PLUMULARIIDÆ.

*Antennularia antennina*, Linnaeus.

Recorded by Byerley as being picked up frequently with out polyps. Mersey (J. S. Hicks). Not uncommon (A. O Walker).

Several very large colonies, from three to ten inches in height, with gonothecæ, were obtained from the south end of the Isle of Man in August, 1885.

Obtained in Hilbre Swash on June 20th.

*Antennularia ramosa*, Lamarck.

Recorded by Byerley as being about as common as the preceding species. Mersey (J. S. Hicks).

A small piece, very much broken, showing neither gonothecæ nor nematophores, was dredged from the Welshman's Gut on June 20th, 1885.

*Aglaophenia pluma*, Linnaeus.

*Plumularia cristata*, Johnston, *B. Z.* 92, pl. xxiii, figs. 1–3. pl. xxiv, fig. 1.

Recorded by Byerley under the name of *Plumularia cristata* as having been found on the Bootle coast by Mr. Tudor. Rare, and frequently with polyps alive, parasitic on *Halidrys siliquosa*, Mr. Marrat. Mersey (J. S. Hicks). Also mentioned by Hincks as being common at the Isle of Man. Menai Straits (Pennington). Colwyn Bay (A. O. Walker).

Found at Penmaenmawr in July, 1885, by Mr. Thompson.

*Aglaophenia myriophyllum*, Linnaeus.

*Plumularia myriophyllum*, Johnston, *B. Z.* 99, pl. xxiii, figs. 4, 5.
*Lytocarpus myriophyllum*, Pennington, *Brit. Zooph.*

Recorded by Byerley under the name of *Plumularia myriophyllum* as being very rare; found once by Mr. Marrat at Waterloo, and once between Egremont and Seacombe. Mersey (J. S. Hicks). Isle of Man (Forbes).

*Plumularia pinnata*, Linnæus.

Several very large colonies, from three to four inches in height, all shewing gonothecæ well, were dredged at the Isle of Man during August, 1885.

One colony, shewing gonothecæ on the pinnæ, as well as in double rows on the stem, was dredged off Port Erin, Isle of Man, from a depth of fifteen fathoms.

*Plumularia setacea*, Ellis.

Recorded by Byerley as having been found at Bootle and New Brighton. Not common. Mersey (J. S. Hicks).

*Plumularia catharina*, Johnston.

Common at the Isle of Man (Hincks).

*Plumularia similis*, Hincks.

Mentioned by Hincks as being common at the Isle of Man.

# LIST of the MEDUSÆ and CTENOPHORA of the L. M. B. C. DISTRICT.

By J. A. Clubb,

Assistant in the Zoological Laboratory, University College, Liverpool.

The Medusoid Gonophores enumerated below were all, with the exception of *Thaumantias convexa*, and the species recorded by Mr. Byerley, collected by Professor Herdman off the south end of the Isle of Man, during July and August, 1885. *Thaumantias convexa* was taken by Mr. I. C. Thompson off Penmaenmawr, in July. The true Medusæ and the Ctenophora were obtained at the mouth of the Mersey.

The method of preservation adopted in the case of the Isle of Man specimens was as follows:—The tow-net was inverted in a large jar, containing about a gallon of salt water, to which about five or six grains of picric acid was added. The Medusoid Gonophores, and other organisms, which settled in a layer at the bottom of the jar, were shortly afterwards removed from the solution, and placed in weak alcohol. In the case of many of the Medusoid Gonophores so treated, there was found to be considerable contraction, especially of the tentacles, and the colour was always obliterated by the yellow staining due to the picric acid. Hence there is considerable difficulty in identifying them, and, in a few cases, the specimens are in such a condition that the species cannot be satisfactorily determined.

The specimens have been examined and identified in the Laboratory, under the direction of Professor Herdman; and I have followed the nomenclature given by Professor Edward Forbes in his "Monograph of the British Naked-eyed Medusæ," Ray Society, 1848.

Of the four species of Medusoid Gonophores recorded by Byerley, in 1853, not one has been found by the L. M. B. C.; and of the four species of the true Medusæ, recorded from the neighbourhood by Byerley, only the two commoner species were obtained during last Summer's investigations.

## HYDROMEDUSÆ.*

### Order.—HYDROIDA.

#### Family.—CLAVIDÆ.

*Turris neglecta*, Lesson.

"Taken rarely in the Mersey, by Mr. Price" (Byerley).

#### Family.—CORYNIDÆ.

*Sarsia tubulosa*, Sars.

"Caught in the Mersey. Rare. Mr. Price" (Byerley).

#### Family.—ATRACTYLIDÆ.

*Bougainvillia britannica*, Forbes.

Several specimens of this species were taken on August 1st (mid-day); on August 21st; and one specimen on August 22nd (noon, stiff breeze), off Port Erin, Isle of Man. The specimens were all small. This species is new to the locality.

#### Family.—COMPANULARIIDÆ.

*Thaumantias pilosella*, Forbes.

Found abundantly by Mr. Garner,† in Douglas Bay.

*Thaumantias octona*, Forbes.

This species is fairly common off Port Erin, Isle of Man. Specimens were obtained on August 19th, 21st, and 22nd.

Some of the specimens differ from Forbes' description in having the tentacles much shorter and thicker, and the tentacle-bulbs larger. Also, in one or two specimens, I could

* For the Hydroid forms of the Hydromedusæ, see *Report on the Hydroida*, p. 95.

† *Holiday Excursions of a Naturalist*, p. 82. 1867.

only make out one colourless tubercle between the tentacles, whereas Forbes describes two. This species is new to the locality.

*Thaumantias convexa*, Forbes.

Found by Mr. I. C. Thompson, off Penmaenmawr, in July, 1885. This species is new to the locality.

*Thaumantias thompsoni*, Forbes.

This species was obtained in fairly large numbers, on four different occasions, off Port Erin, Isle of Man, viz., on August 1st, 19th, 21st, and 22nd.

The specimens are generally small and contracted, the breadth of the umbrella varying, after preservation in picric acid and alcohol, from about $\frac{1}{16}$ inch to $\frac{1}{8}$ inch; while Forbes describes it as being, when living, and full-grown, about $\frac{1}{4}$ inch across the umbrella. This species is new to the locality.

*Thaumantias hemisphærica*, Müller.

This species was obtained in great profusion on August 21st, from the sheltered harbour of Port Erin, Isle of Man, inside the Breakwater. I may here remark that the surface material of August 21st was the most fruitful in Medusoid Gonophores, four species in all being obtained; thus bearing out Forbes' statement, that "they (Medusoid Gonophores), abound most in sheltered bays." This species was also obtained on the following day, August 22nd, but in much smaller numbers. The specimens varied very much in size, and the adult formula of Forbes for the tentacles $(7 \times 4 + 4)$ was by no means constant. This species is new to the locality.

*Thaumantias lucida*, Forbes.

*Medusa hemisphærica*, var. *lucida*, Macartney, *Phil. Trans.* (1810).

Two small specimens only of this species occurred on

August 1st, off Port Erin, Isle of Man. This species is new to the locality.

*Thaumantias punctata*, Forbes.

"Rare in the Mersey" (Byerley). This species was obtained off the Isle of Man, in June, 1839, by Professor Forbes (*British Naked-Eyed Medusæ*, p. 53).

Family.—Leptoscyphidæ.

*Lizzia octopunctata*, Sars.

"Taken by Mr. Price, in the River Mersey." (Byerley).

## Order.—ACALEPHA.

### Sub-order.—DISCOPHORA.

Family.—Aurelidæ.

*Aurelia aurita*, Linn.

"Mr. Price, who has paid great attention to this beautiful tribe of animals, finds this species most abundantly about the month of May every year" (Byerley). It was obtained by members of the L. M. B. C., during last summer, stranded on the shore at New Brighton.

Family.—Pelagidæ.

*Chrysaora hyoscella*, Esch.

"Rare. Seen mostly during the months of July and August" (Byerley). This species has not yet been obtained by the L. M. B. C.; but Mr. Walker informs me that it is frequently very common all along the coast.

Family.—Cyaneidæ.

*Cyanæa capillata*, Esch.

"A very common species. Appears on our shores from July to October. Mr. Price has observed a yellow Medusa, very like this species, during the May month" (Byerley).

This species has been obtained by the L. M. B. C., stranded on the shore at New Brighton.

### Family.—Rhizostomidæ.

*Rhizostoma pulmo*, Linn.

"This large species may be considered rare in the district. Mr. Price informs me that he has commonly observed about three or four in a year. Mostly seen in the month of September, and later in the year" (Byerley). This species has not been found during the last year; but Mr. Walker states that it is sometimes very common, and that he has often seen many hundreds in a day.

[None of the Siphonophora belong properly to the Liverpool Bay Fauna, but Mr. T. J. Moore informs me that numerous specimens of *Physalia pelagica* were found cast ashore at Southport, after strong westerly gales, at the end of Feb., 1860, and several examples were obtained for the Liverpool Museum.]

## CTENOPHORA.

### Order.—SACCATA.

### Family.—Cydippidæ.

*Pleurobrachia pileus*, Flem.

This species appeared in great profusion in the neighbourhood of Hilbre Island, towards the end of May, 1885. A few specimens were also obtained by Professor Herdman off the south coast of the Isle of Man, during the month of August, in the same year.

Byerley records it as being "found mostly early in April, but also, more sparingly, at other times." Mr. Price* records it as being very plentiful at Woodside Slip, in 1834.

* *Old Price's Remains*, Liverpool.

*Pleurobrachia pomiformis.*

"Very rare" (Byerley). Has not yet been obtained by the L. M. B. C.

## Order.—EURYSTOMATA.

### Family.—Beroidæ.

*Beroe ovatus*, Lam.

"Irregular in the time of its appearance, but sometimes as early as *Cydippe pileus*" (Byerley). Has not yet been obtained by the L. M. B. C.

## Order.—LOBATA.

### Family.—Mnemiidæ.

*Bolina hibernica.*

This species (= *Alcinoë vermiformis*, Cuvier) has been found twice by Mr. Price at Birkenhead.

# REPORT on the ALCYONARIA of the L. M. B. C. DISTRICT.

By Professor Herdman, D.Sc.

Only two species belonging to the Alcyonaria—the common *Alcyonium digitatum* and the rare *Sarcodictyon catenata*—can be recorded here. None of the British Pennatulida, although they all occur on the West Coast of Scotland, have yet been found in this neighbourhood.

## ALCYONARIA.

### ALCYONIDA.

#### Family I.—Cornularidæ.

*Sarcodictyon catenata*, Forbes (Pl. II, figs. 1 and 2).

Several colonies of this rare species were dredged in August, 1885, between Port St. Mary and Spanish Head, Isle of Man, from a depth of twenty fathoms; bottom, Nullipores. They all belong to the red variety, and one of them shows that widening of the stolon in places to form expansions upon which the polypes are grouped in twos and threes, which Forbes supposed to be characteristic of his *Sarcodictyon agglomeratum*.* The colonies vary in size from three to nearly thirty polypes. They agree in all respects with the Scotch specimens described in my paper on *Sarcodictyon* referred to below.

In specimens of *Sarcodictyon catenata*, dredged from Loch Fyne, I had never succeeded in inducing the polypes to expand in captivity, but in the case of a large colony obtained in Lamlash Bay, in the autumn of 1884, and again

* See Forbes, *Trans. Roy. Soc.*, Edin., vol. xx, p. 307, 1853; and Herdman, *Proc. R. Phys. Soc.*, Edin., vol. viii, p. 31, 1883.

in the colonies dredged off the Manx coast, after being kept in an aquarium for a few days, the polypes expanded fully, and then presented the appearance shewn in Pl. II, figs. 1 and 2. Figure 1 represents the colony, about natural size, and figure 2 one of the polypes enlarged. These shew that the polype may expand to over three times its normal height, the clear upper part of the body being about twice the length of the opaque lower part. This expanded upper part of the body is of a translucent white colour. The tentacles are exceedingly slender and graceful, and may be extended to a great length; they are usually as long as the entire body of the polype. They are very delicate, and have an entirely different shape from that which they present when dead and preserved in alcohol.* The stomodæum is usually distinctly visible in the expanded polype (see Pl. II, fig. 2) as a less translucent white band running from the mouth downwards to the opaque red lower part of the body.

The colonies which expanded in captivity were very sluggish in their movements, and slow in responding to stimulation. The specimens were dredged and placed in the small aquarium on August 7th, and it was not until August 12th that the first polype of the first colony elongated its body and expanded its tentacles. On the following day (Aug. 13th), the whole colony of fifteen polypes was in a completely expanded condition (see Pl. II, fig. 1). But when once expanded the polypes remained so, with very slight movement of any kind, and it was not very easy to induce them to retract the tentacles—agitation of the water surrounding them, and even shaking of the stone to which they were attached, seemed to have no effect whatever. When the tentacles were pricked with the point of a needle they slowly retracted, and if the irritation was continued the upper part of the body wall was slowly and gradually drawn inwards

* Herdman, *loc. cit.*, see pl. i, figs. 8, 9, 10.

until the polype was completely retracted. But the neighbouring polypes of the same colony were not affected in the least degree; they remained in a fully expanded condition. On the following day (Aug. 14th), the polypes were all retracted, and they remained in that condition until August 18th, when a few of them again became elongated and showed their tentacles. On the next day again, most of the colony was fully expanded for a short time, and then all the polypes retracted until August 21st, when a few of them again expanded for the last time. On this day, the second colony in the aquarium expanded for the first time, exactly a fortnight after it was dredged. Some of the polypes of this second colony expanded again on August 23rd, and a few days later, both colonies were placed in alcohol.

### Family II.—Alcyonidæ.

*Alcyonium digitatum*, Linn.

This species is fairly abundant at Hilbre Island at low water mark, attached to the rocks. Byerley records it also from New Brighton and shore-pools at Egremont, where, however, the specimens were much smaller. There are probably none at all in these latter localities now. Both the common varieties, the deep orange and the pure white, are found at Hilbre. As in the case of *Sarcodictyon catenata*, the difference in colour is entirely due to the spicules.

This species was also dredged between Port St. Mary and the Calf, Isle of Man, from a depth of fifteen fathoms, during August; and it was obtained on the "Spindrift" Expedition, off Point of Ayr; and in Hilbre Swash, on several occasions, from depths of nine to eleven fathoms. During the cruise of the "Hyæna," it was dredged to the north of Puffin Island, from a depth of fourteen fathoms.

# REPORT on the ACTINIARIA of the L.M.B.C. DISTRICT.

By John W. Ellis, L.R.C.P., F.E.S.

The classification and nomenclature of species given by Dr. Andres * in his recent monograph on the Actiniæ of the Bay of Naples have been followed in this Report, but the old and well-known names used by Gosse † and other writers on British Anemones have been inserted, when required, as synonyms.

## ACTINIARIA.

### Family.—Actinidæ.

#### Sub-family.—Halcampinæ.

*Halcampa chrysanthellum*, Peach (?).

A single specimen of a species, which from the presence of twelve tentacles only would seem to be correctly placed in this genus, was dredged from a depth of ten to twenty fathoms off the S.E. coast of the Isle of Man, by Professor Herdman, in August, 1885, but from its contracted state and loss of colour, the specimen is not capable of being identified. Very probably it is *Halcampa chrysanthellum*, which according to Professor Haddon, is a very variable species, and is found on the Irish coast, near Dublin.

#### Sub-family.—Sagartinæ.

*Actinoloba dianthus*, Ellis (1767).

This species, the Plumose anemone, is probably one of the most common anemones in the immediate vicinity of Liverpool.

* *Fauna und Flora des Golfes von Neapel. IX Monographia. Die Actinien. Leipzig*, 1884.

† *Actinologia Britannica, London*, 1860.

It is recorded by Byerley as being found at "Hilbre Island at low ebbs; some specimens pure white, and others of a deep buff colour. The white variety is plentiful on the Dingle shore."

Mr. Wood, the attendant in the aquarium at the Derby Museum, Liverpool, informs me that the species still occurs on the pontoons of the Liverpool landing-stage, the locality recorded by Gosse in *Actinologia Britannica.* Fine specimens are frequently procured by him for the tanks at the museum at extreme low water-mark on the Leasowe shore, opposite the embankment, on a gravelly and stony bottom, the handsome semi-translucent white specimens (var. *sidonea*, Gosse) being the most plentiful. In one of the tanks at the museum there are now (December, 1885) two beautiful specimens, found by him in this locality, with the column of a rich purple-brown and the tentacles pure white; evidently a form of the variety *brunnea*, Gosse.

A few large specimens, all of the white variety, have been dredged during the expeditions of the Marine Biology Committee; and in one of the shore excursions to Hilbre Island, a large number of the flesh-coloured variety (*rubida*, Gosse), all, however, very young, were found studding an overhanging detached piece of rock at the extreme north end of the island. Professor Herdman found small specimens of this form at the south end of the Isle of Man in August last. Mr. Gosse (*Actinologia Britannica*) records this species from Morecambe Bay, his authority being Mr. F. H. West. Mr. A. O. Walker has taken the variety *sidonea* in Colwyn Bay; and Mr. J. Chard has taken the species at Moelfra Bay, Anglesea.

*Heliactis bellis*, Ellis and Solander (1786).

*Sagartia bellis*, Gosse and other authors.

Recorded from Puffin Island and from the Isle of Man, by Gosse, in *Actinologia Britannica.* We have no record of its occurrence in the immediate vicinity of Liverpool.

*Heliactis miniata*, Gossé (1853).

*Sagartia miniata*, Gosse and others.

The Menai Straits and Hilbre Island are given by Gosse as localities for this species, but no specimens have been found there by members of the Committee.

*Heliactis venusta*, Gosse (1854).

*Sagartia venusta*, Gosse.

This species was obtained in the vicinity of the Calf of Man, by Professor Herdman, in August last. It is also recorded from Puffin Island by Gosse, on the authority of Mr. E. L. Williams.

*Cylista viduata*, Müller (1776).

*Sagartia viduata*, Gosse.

This is a species which is recorded by Gosse as abundant in the Menai Straits, and also as occurring at Puffin Island, and at the mouth of the River Dee, but which, so far as can be ascertained, has not been procured during the expeditions of the Marine Biology Committee. It was found at Beaumaris on August 13th, 1881, by Mr. A. O. Walker.

*Cylista undata*, Müller (1788).

*Sagartia troglodytes*, Johnston (1847).

Recorded by Gosse as occurring in the Menai Straits and the estuary of the Mersey, and at Birkenhead, Hilbre Island, Morecambe Bay, and the Isle of Man. Recorded by Byerley as having been found upon the Leasowe Shore and near Egremont Slip. Mr. Byerley (*Fauna*, p. 106), gives an account of the habits of this species in captivity.

This species was found very abundantly during one of the shore expeditions of the Marine Biology Committee to Hilbre Island, but out of a very large number of individuals collected and observed, very few differed from the type form as described by Gosse (var. *scolopacina*). Several specimens were noticed

with orange tentacles surrounding a dull blue disc, but these were so injured by the attempt to detach them that they died without expanding, and whether these belonged to the variety *nobilis*, Gosse, first brought under his notice by the Honourable Lady Cust, will remain for future observations to verify. This variety was found by Mr. Walker at Llandrillo, in 1879.

Among the specimens brought home by myself on this occasion (July 11th, 1885), was one which I was quite unable, after repeated endeavours, to identify with any of the varieties of this most protean species described by Gosse. This form is so very distinct that I have ventured to append a description and a figure of it, and since it possesses a disc of the purest white, I propose the name of var. *candida* for it. The following is a description taken from the specimen during life.

*Cylista undata*, Müll., var. *candida*, nov. (see Pl. II, figs. 3 and 4).

Column.—Capable of great elongation, pale drab, with darker longitudinal lines at the base, disappearing at about half the height.

Disc.—Pure opaque white, the radii not indicated; the extreme margin of the disc is translucent deep purple.

Mouth.—Concolorous with the disc, slightly elevated on a cone.

Tentacles.—Not very numerous, in about five rows, the inner ones being longest. All are pellucid grey, tipped with opaque white; the inner row, six in number, have a dark purple longitudinal stripe on the face and back; the remainder have similar stripes of scarlet, the whole of the base of the tentacle being suffused with the same colour as the stripe. Near the foot of the inner tentacles only, is a faintly indicated dark cloud representing the B mark of the typical form of this species.

Habitat.—Hilbre Island, at the extreme north extremity, near low-water mark.

The varieties of *Cylista undata* recorded by Mr. P. H. Gosse as inhabitants of our district, principally on the authority of Mr. F. H. West, are as follows:—

| | | |
|---|---|---|
| Var. | *hypoxantha* ... ... | Morecambe Bay. |
| ,, | *badifrons* ... ... | do. |
| ,, | *albicornis* ... ... | do. |
| ,, | *nigrifrons* ... ... | do. |
| ,, | *fulvicornis* ... ... | do. |
| ,, | *pallidicornis* ... ... | do. |
| ,, | *melanoleuca* ... ... | do. |
| ,, | *auricoma* ... ... | do. |
| ,, | *luna* ... ... ... | do. |
| ,, | *nox* ... ... ... | do. |
| ,, | *eclipsis* ... ... | do. |
| ,, | *nycthamera* ... ... | do. |
| ,, | *nobilis* .. ... | Cheshire coast. |

*Adamsia palliata*, Bohadsch (1761).

Recorded from the Isle of Man, by Gosse.

Several specimens were dredged off Spanish Head, between Port St. Mary and the Calf, Isle of Man, from a depth of twenty fathoms, by Professor Herdman, these being, as usual with this species, attached to shells inhabited by the hermit-crab, *Pagurus prideauxii*.

*Sagartia sphyrodeta*, Gosse (1858).

Recorded (Gosse's *Actinologia Britannica*) from Hilbre Island, on the authority of Mr. E. L. Williams.

Sub-family.—ACTININÆ.

*Actinia equina*, Linné (1766 to 1768).

*Actinia mesembryanthemum*, Ellis and Solander (1786).

This species, in most localities the commonest anemone,

is not at all common in the district investigated by the Marine Biology Committee. It has only been taken by members of the Committee on the Manx coast. The fact of its absence from the Mersey district is thus noted by Gosse * :—

"It is a curious fact, for which I am indebted to Mr. E. M. Williams, Jun., that 'the Mersey estuary is the only place on the coasts where he has not found this species,' which he attributes to the foulness of the water. This absence would be less remarkable were it not that *Tealia crassicornis* is abundant there; but *Actinia* is clean and *Tealia* is dirty in its habits. In the neighbouring estuary of the Dee the former is common as usual."

Byerley, in his *Fauna*, remarks:—"Mr. Price states that he met once with this species upon our shore. I have a specimen now (1855) alive, which I took at Hilbre; rare on this coast until this year, when several have been taken." It has not been found at Hilbre Island on any of the expeditions of the Liverpool Marine Biology Committee during 1885. The species is common at the south end of the Isle of Man, and also at Colwyn Bay.

*Anemonia sulcata*, Pennant (1766).

*Anthea cereus*, Auct.

This species has been obtained by one of the members of the Committee, at Douglas, Isle of Man, the only locality in our district recorded for this species by Gosse, but the contracted and bleached state of the specimens prevents any differentiation of varieties. It was also obtained in rock pools on the shore at Port Erin, Isle of Man.

Sub-family.—Bunodinæ.

*Tealia crassicornis*, Müll. (1776).

This is probably the species referred to as *Actinia coriacea* by Byerley. It is abundant throughout the dis-

* *Actinologia Britannica.*

trict, but it has nearly disappeared from one locality where it used to be common, viz., below the New Brighton light-house. Most of the specimens seem to belong to the ordinary type form, but Professor Herdman noticed specimens at the Isle of Man which answer to the descriptions of the varieties *insignis* and *purpurea* of Gosse, while one of the latter form is now in one of the tanks at the Liverpool Museum.

Mr. Price recorded the species from New Brighton thirty years ago. It was then very abundant.

*Bunodes gemmaceus*, Ellis and Solander (1786).

Recorded by Gosse, from Douglas, Isle of Man.

Professor Herdman obtained a number of specimens of this species at Port Erin. The medium-sized specimens shew best the characteristic variation in the size and colour of the warts.

### Family.—Stichodactylidæ.

#### Sub-family.—Corynactinæ.

*Corynactis viridis*, Allman (1846).

This species, which is recorded from the Irish coast by Gosse, was obtained by Professor Herdman, by dredging in deep water off Spanish Head, at the south extremity of the Isle of Man, in August last. From descriptions given to me of the appearance of the specimens during life, I believe these to be of the variety *rhodoprasina*, Gosse.

*Capnea sanguinea*, Forbes (1841).

Obtained by Professor Forbes, "in deep water off the Isle of Man, on Nullipore beds." Since, with the exception of Falmouth, this is the only locality recorded for this beautiful species, it is very desirable that it should be specially looked for in any future dredgings off the Manx coast.

### Family.—Zoanthidæ.

#### Sub-family.—Zoanthinæ.

*Polythoa arenacea*, Delle Chiaje (1836).

*Zoanthus couchii*, Johnston (1838).

Several examples of this species, which is not recorded by Gosse from any locality nearer to us than the Irish coast, were obtained by Professor Herdman, along with *Corynactis viridis*, off Spanish Head, at the south end of the Isle of Man, from a depth of twenty fathoms. This is therefore a new locality for both these species. The specimens are adherent to fragments of a Nullipore.

### Family.—Cerianthidæ.

#### Sub-family.—Cerianthinæ.

*Cerianthus lloydii*, Gosse (1859).

So named by Mr. Gosse from its discoverer, Mr. Alfred Lloyd, who found it in the Menai Straits, in July, 1856. This species also deserves to be specially looked for in future expeditions.

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Of the twenty species of Actiniaria recorded by Gosse as inhabiting the Irish Sea (for one of which, however, *Sagartia nivea*, he gives no Irish Sea locality), seventeen are known to inhabit the Liverpool Bay district, and of these eleven have been collected by members of the Committee.

Only four distinct species (*Actinia equina, Cylista undata, Tealia crassicornis*, and *Actinoloba dianthus*) are recorded in Byerley's list. They were all obtained in the immediate neighbourhood of Liverpool.

# REPORT upon the CRINOIDEA, ASTEROIDEA, ECHINOIDEA, and HOLOTHUROIDEA of the L. M. B. C. DISTRICT.

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PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

THIS Report deals with all the groups of the Echinodermata with the exception of the OPHIUROIDEA, which are discussed in a separate paper by Mr. H. C. Chadwick (see p. 140). Most of the species were obtained off the southern end of the Isle of Man, where there is a rich and varied Echinoderm fauna. In the immediate neighbourhood of Liverpool comparatively few species were obtained, although some of them exist in great profusion (*e.g., Asterias rubens* at Hilbre Island). The numbers of species to be recorded in the different Echinoderm groups are as follows :—Crinoidea, 1 ; Asteroidea, 11 ; Echinoidea, 6 ; Holothuroidea, 5. Mr. Chadwick (p. 140) discusses six species of Ophiuroidea, making in all twenty-nine Echinodermata.

For previous records of occurrence I have made use of Mr. Byerley's *Fauna*, Forbes' *British Star Fishes*, *The British Association Report upon Marine Zoology*, and a List compiled by the Isle of Man Natural History Society, in 1884. I have to thank my friend, Professor Jeffrey Bell, for assistance in regard to the nomenclature and synonymy of some of the species.

## CRINOIDEA.

### Family.—COMATULIDÆ.

***Antedon rosaceus***, Link.

*Comatula rosacea*, Link. Forbes, *British Star Fishes*, p. 5.

This species occurs in deep water around the shores of

the Isle of Man. It has been dredged by Mr. R. Garner off Douglas Bay, and near Port Erin and The Calf. It is also recorded by Forbes (*Brit. Assoc. Rep.*, 1850), as having been taken off the Isle of Man in twenty-five fathoms.

It occurred in abundance in depths of from ten to twenty fathoms off Port Erin, Port St. Mary, and Spanish Head, at the southern end of the Isle of Man, last summer. The specimens were of fair size, and shewed the usual variations in colour; yellow, tawny, orange, and crimson individuals being obtained.

Some of the specimens of *Antedon* were infested with the interesting little ectoparasite, *Myzostoma*.

The Pentacrinoid larvæ of *Antedon* were obtained during the last week of July and first fortnight of August, attached to seaweeds, from a depth of ten to twenty fathoms, off Port Erin, Isle of Man.

## ASTEROIDEA.

### Family.—Asteriadæ.

*Asterias rubens*, Linn.

This species, the *Uraster rubens* of Forbes' *British Star Fishes*, and of Byerley's *Fauna*, is exceedingly abundant on the rocks at the north end of Hilbre Island, between tide marks. In some places the star fishes are so closely placed as to almost entirely cover the rocks for some yards. They seem to have been increasing in numbers at Hilbre Island of late years, and possibly they may be driving away or exterminating some of the other animals of the littoral zone.

The common star fish is also found in this neighbourhood by dredging. It was obtained in abundance, and of large size, in Hilbre Swash, during the "Merry Andrew" and "Spindrift" expeditions, and was dredged, during the cruise of the "Hyæna," off the Great Ormes Head, depth seven to eight fathoms, on May 23rd, 1885.

It is plentiful around the south coast of the Isle of Man, and also in the neighbourhood of Penmaenmawr, and at Fleetwood.

*Asterias glacialis*, Linn.

This large species, the *Uraster glacialis* of Forbes and other authors, has been taken in deep water off the Manx coast (Wallace, recorded by Forbes), and has also been found at Port Erin and the Calf of Man, by Mr. Garner.* It has apparently not been found nearer Liverpool. The species is not uncommon further up the west coast. I have dredged it in Lamlash Bay,† Arran, and at the entrance to Loch Fyne, and in the Sound of Mull.

*Asterias hispida*, Pennant.

*Uraster hispida*, Penn. Forbes, *British Star Fishes*, p. 95.

I have referred to this species a small star fish with short and rather rounded rays, which was obtained during the cruise of the "Hyæna," on May 24th, 1885, in the entrance to the Menai Straits, near Bangor. The specimen measures 2·5 cm. in diameter, and seems to agree with the description and figure given by Forbes.

This species was originally found by Pennant in Anglesea, and Dr. Coldstream came upon it on the limestone rocks, near Castletown, Isle of Man.

## Family.—Solasteridæ.

*Cribrella sanguinolenta*, Sars.

*Cribella oculata*, Penn. Forbes, *British Star Fishes*, p. 100.

Several specimens of this species were dredged off Port Erin, and between Port St. Mary and The Calf, Isle of Man, during August, 1885. It has not been recorded from the

* *The Holiday Excursions of a Naturalist*, by R. Garner, 1867.

† "Notes on the Fauna of Lamlash Bay." *Proc. Roy. Phys. Society, Edin.*, vol. v, p. 193, 1880.

immediate neighbourhood of Liverpool, and does not occur in the list of Echinodermata drawn up by the Isle of Man Natural History and Antiquarian Society* in 1884. It was found, however, by Pennant, on the shores of Anglesea; and Forbes, in his *British Association Report*,† records having dredged the species both off the Isle of Man and off the North Wales coast, from depths of twenty to twenty-five fathoms. Mr. A. O. Walker informs me that he has found it on the shore at Colwyn Bay.

The Manx specimens which we have found are rather small, and have the rays relatively narrower, and the upper surface less spinose, than is usual in the species.

*Solaster endeca*, Linn.

Forbes (*Brit. Star Fishes*, p. 111) records this species as being not rare in deep water off the Isle of Man. We have not found it.

*Solaster papposa*, Linn.

This common species, the sun-star, is recorded by Byerley as being not uncommon at Hilbre Island, Caldy Blacks, New Brighton, &c. Forbes dredged it in deep water around the Isle of Man, and also off the North Wales coast.

This species was obtained frequently, during last August, off the southern end of the Isle of Man. It was also obtained during the cruise of the "Hyæna," off the Great Ormes Head, depth seven to eight fathoms, on May 23rd; and north of Puffin Island, depth eleven to thirteen fathoms, on May 24th. It has been found on shingle at low water at Blackpool.

Family.—ASTERINIDÆ.

*Asterina gibbosa*, Pennant.

This small species was obtained in abundance during

* For a copy of this paper I am indebted to the President of the Society, Mr. P. M. C. Kermode, of Ramsey.

† "Report on British Marine Zoology," Part I, *British Association Report*, 1850, p. 211.

July and August, 1885, at various points on the eastern, southern, and western shores of the Isle of Man. It was found at Bay-ny-Carriekey, near Poyllvaaish, Port St. Mary, Port Erin, Fleshwick Bay, etc., always in tidal pools, and usually attached to *Corallina officinalis*.

Prof. Forbes and Dr. Coldstream found the species in tidal pools at Castletown, Isle of Man, and Mr. R. Garner obtained it from pools amongst the rocks, north-west of the Stack.

The specimens which I have collected vary in extreme diameter from 2·5 mm. to 2·8 cm. They were, when living, nearly all of a dull greenish colour, although a few yellowish and reddish specimens also occurred. The specimens from Port St. Mary and the neighbourhood were much larger than those from Port Erin.

*Palmipes membranaceus*, Retz.

"This species is by no means uncommon in deep water off the coast of the Isle of Man, where I have dredged many specimens." (Forbes, *Brit. Star Fishes.*)

*Porania pulvillus*, Gray.

*Goniaster templetoni*, Forbes, *Wern. Mem.*, and *Brit. Star Fishes*, p. 122.

Recorded by Forbes from deep water, off the Isle of Man; and by Garner from near The Calf.

Family.—ASTROPECTINIDÆ.

*Astropecten irregularis*, Penn.

*Asterias aurantiaca*, Linn. Forbes, *Brit. Star Fishes*, p. 130.

This species is recorded by Forbes from the Manx coast, and from the coast of North Wales. It is often found cast ashore by storms at Penmaenmawr (Darbishire); and has been found at Formby Point (G. H. Morton).

A very fine specimen, with the Annelid *Malmgrenia*

*castanea* stretched along one of the ambulacral grooves, was dredged during the cruise of the "Hyæna," from a depth of fourteen fathoms, at about six miles north of the Great Ormes Head.

*Luidea savignii*, Audouin.

*Luidea fragillissima*, Forbes, *Brit. Star Fishes*, p. 135.

Prof. Forbes states that he has taken this species several times on the Manx coast—always with seven rays.

## ECHINOIDEA.

### Order I.—DESMOSTICHA.

#### Family.—Echinidæ.

*Echinus esculentus*, Linn.

This common species, the *Echinus sphæra* of Forbes' *British Star Fishes*, and other works, is common off the south end of the Isle of Man. It was taken frequently last summer in the neighbourhood of Port Erin, and some very large specimens occurred. In one case the Annelid *Hermadion assimile* was found coiled around the edge of the peristome of the *Echinus*.

One or two specimens have been found, cast ashore near Liverpool, by Mr. Marrat (Byerley); and it was obtained at low tide at Hilbre Island, on June 13th, 1885.

Forbes (*Brit. Assoc. Rep.*) records this species from the Isle of Man, but not from the shores of North Wales. It was obtained during the cruise of the "Hyæna," between Puffin Island and Anglesea, on May 25th, 1885, and was taken by Mr. Thompson in the neighbourhood of Penmaenmawr.

*Echinus miliaris*, O. F. Müller.

This species is recorded by Mr. Byerley as having been taken sparingly in the dredge at the entrance of the Dee; and by Prof. Forbes from the Isle of Man, and from the coast of North Wales.

It was obtained during the cruise of the "Hyæna" near Puffin Island, on May 24th; and was taken frequently in the neighbourhood of Port Erin and Port St. Mary, at the south end of the Isle of Man, last summer. The largest specimens measure from 1 cm, to 1·5 cm. in diameter (exclusive of spines). It was also obtained in the neighbourhood of Penmaenmawr in July.

## Order II.—CLYPEASTRIDA.

### Family.—Euclypeastridæ.

*Echinocyamus pusillus*, Gray.

This little species is not uncommon in this locality. Byerley records having taken several specimens by dredging; and Forbes (*Brit. Assoc. Rep.*) has found it both at the Isle of Man and also on the North Wales coast. It was obtained by the Marine Biology Committee, at the following places in the district during last year's investigations:—(1.) During the cruise of the "Hyæna," on May 23rd, off the Great Ormes Head, depth seven to eight fathoms. (2.) Off the south end of the Isle of Man, near Port Erin, ten to twenty fathoms, and off Spanish Head, fifteen fathoms, bottom Nullipores. (3.) At Hilbre Island, at low tide, on June 13th, 1885.

Some dead tests of this species were found worked into the sandy investments of *Molgula occulta*, dredged off Port Erin, Isle of Man.

## Order III.—PETALOSTICHA.

### Family—Spatangidæ.

*Spatangus purpureus*, Müller.

Forbes (*Brit. Star Fishes*, p. 182) records this species as being abundant on the scallop-banks, off the Isle of Man. He has also found it off the coast of North Wales, at a depth of

twelve fathoms. It is found living of large size at low water in muddy gravel near Beaumaris (Darbishire).

One rather small specimen was dredged in August, off Port Erin, Isle of Man, from a depth of fifteen fathoms.

*Echinocardium cordatum*, Pennant.

*Amphidotus cordatus*, Penn. Forbes, *Brit. Star Fishes*, p. 190.

This species is common in the locality. Byerley records having dredged living specimens, and found dead shells cast ashore. It is very abundant at low water from Penmaenmawr to Southport.

It has been found by the Marine Biology Committee at various points on the coast.

*Echinocardium flavescens*, O. F. Müller.

*Amphidotus roseus*, Forbes, *Brit. Star Fishes*, p. 194.

This species was found by Forbes, in deep water, on the Manx coast, and also on the North Wales coast.

It was dredged last August off Port Erin, Isle of Man, from a depth of fifteen to twenty fathoms; and a number of small specimens, about 7 mm. in greatest length, probably belonging to this species, were dredged off Bradda Head, near Port Erin, from a depth of fifteen fathoms.

## HOLOTHUROIDEA.

### Order.—PEDATA.

### Family.—DENDROCHIROTÆ.

*Thyone papillosa*, Müller.

Forbes dredged this species on the scallop-banks, off the Isle of Man, in 1838, and a single specimen was obtained in August, 1885, from a depth of fifteen fathoms, off Port Erin, Isle of Man.

*Thyonidium drummondii*, Thompson.

*Cucumaria drummondii*, Thompson.
*Cucumaria communis*, Forbes and Goodsir.
*Thyone portlockii*, Forbes.

Byerley states that a single specimen of *Cucumaria communis* was obtained by a fisherman at Hoylake. Probably it was the present species.

A large Holothurian which was found cast ashore alive on the north end of Hilbre Island by the Committee agrees closely with Forbes' description and figure of *Thyone portlockii*, which is identical with *Thyonidium drummondii*. It has also been found on the beach at Penmaenmawr.

*Ocnus brunneus*, Forbes.

= *Ocnus lacteus*, Forbes and Goodsir (?)

Forbes records this species from the Isle of Man, and a small specimen was dredged in August, 1885, from a depth of fifteen fathoms, off Spanish Head, Isle of Man.

*Cucumaria pentactes*, Müller.

This species is recorded by Forbes (*Brit. Assoc. Rep.*) from the Isle of Man, twenty fathoms.

A single specimen was obtained during the cruise of the "Hyæna," on May 24th, 1885, near Puffin Island, from a depth of fourteen fathoms.

*Cucumaria hyndmanni*, Thompson.

A single specimen of this species was dredged in August, 1885, from a depth of twenty fathoms, off Port Erin, Isle of Man,

# REPORT on the OPHIUROIDEA of the L. M. B. C. DISTRICT.

By Herbert C. Chadwick.

The specimens of Ophiuridæ, or Brittle Stars, collected in the dredging expeditions of the Liverpool Marine Biology Committee, during the summer of the year 1885, and placed in my hands for examination, include examples of six well-known species, referable to five genera. None of the specimens present features of special interest.

## OPHIUROIDEA.

### Family.—Ophiuridæ.

*Ophioglypha ciliata*, Retzius (sp).

*Asterias ciliata*, Retzius, *Diss, sistens species cognitas Asteriarum*, p. 29, 1805.

*Ophioglypha ciliata*, Ljungman, Dr. Goës, *Oph. Öf. Kong. Akad.*, p. 651, 1871.

*Ophiura texturata*, [pars], Lamarck, *Hist. Anim. sans Vert.*, p. 542; Forbes, *Wern Mem.*, vol. viii, p. 125, pl. 4, figs. 3, 4; *British Star Fishes*, p. 22.

*Ophioglypha lacertosa*, Lyman, *Ill. Cat. Mus. Comp. Zool.*, No. I, p. 40; Ludwig, *Echin. des Mittelmeeres*, p. 546.

Specimens of this species were dredged from a muddy bottom, at a depth of ten fathoms, in the Menai Straits, off Bangor, during the cruise of the "Hyæna." Associated with the next species it occurs in considerable numbers in that locality. It was also found off Port Erin during August. Mr. Byerley * records it as having been taken at

* Isaac Byerley "Fauna of Liverpool," *Proc. Lit. and Phil. Soc. of Liverpool*, 1853–4, No. VIII, Appendix.

Hilbre Island, and dredged at various points around the coast. It has been found at Formby Point by Mr. Morton.

*Ophioglypha albida*, Forbes (sp).

*Ophiura albida*, Forbes, *Wern. Trans.*, vol. viii, p. 125, pl. 4, figs. 5, 6; *British Star Fishes*, p. 27; Lutken, *Addit. ad Hist.*, part i, p. 39, pl. 1, figs. 2*a*, *b*

*Ophioglypha albida*, Lyman, *Ill. Cat. Mus. Comp. Zool.*, No. I, p. 49, 1865; Ludwig, "Anatomie der Ophiuren," *Zeits. für Wissen. Zoologie*, vol. xxxi, p. 241; *Echin. des Mittelmeeres*, p. 547.

This species, associated with the foregoing, occurs in great numbers in the Menai Straits, where it was dredged during the cruise of the "Hyæna," on May 24th. It was also dredged in August, from a depth of twelve fathoms, off Port Erin, Isle of Man; bottom gravel and stones; and from depths varying from ten to twenty fathoms, off Spanish Head and Port St. Mary to The Calf, Isle of Man; bottom chiefly nullipore and gravel. Also obtained off Penmaenmawr. Byerley (*loc. cit.*) records it as occurring in deep water about the mouth of the Dee and north of Wirral.

*Ophiopholis aculeata*, Retzius (sp).

*Asterias aculeata*, Retzius, *Asteriæ Gen.*, p. 240, 1783.

*Ophiopholis aculeata*, Gray, *Rad. Animals Brit. Mus.*, p. 25, 1848; Lutken, *Addit. ad Hist.*, part i, p. 60, pl. 2, figs. 15, 16.

*Ophiocoma bellis*, Forbes, *Wern. Mem.*, vol. viii, p. 126; *British Star Fishes*, p. 53.

*Ophiopholis bellis*, Lyman, *Ill. Cat. Mus. Comp. Zool.*, No. I, p. 96, pl. 1, figs. 4–6.

*Polypholis echinata* (?), Duncan, *Journ. Linn. Soc.*, vol. xv, p. 73, pl. 3 (young).

Specimens of this species were dredged in August, off Port Erin, Isle of Man; depth twelve fathoms; bottom gravel and stones; also off Port St. Mary, from a depth of twenty fathoms.

Forbes * records it as occurring commonly in deep water off the Isle of Man.

*Amphiura squamata*, Delle Chiaje (sp).

*Asterias squamata*, Delle Chiaje, *Mem. sulla storia e anatomia degli animali del regno di Napoli*, pl. 34, fig. I, 1828.

*Amphiura squamata*, Sars, *Oversigt af Norges Echinodermer*, p. 21, 1861.

*Ophiocoma neglecta*, Forbes, *British Star Fishes*, p. 30.

*Amphiura neglecta*, Forbes, *Trans. Linn Soc.*, vol. xix, p. 150.

*Amphiura elegans*, Norman, Biology "Valorous" Cruise, *Proc. Roy. Soc. Lond.*, vol. xxv, p. 215.

*Amphipholis lineata*, Ljungman, Dr. Goës, *Öph. Of. Kong, Akad*, p. 634, 1871.

Specimens of this species were dredged during the cruise of the "Hyæna," in the Menai Straits, off Bangor, from a depth of ten fathoms; bottom muddy. It was again taken in August, from a depth of twelve fathoms, off Port Erin, Isle of Man ; and from rock-pools at Fleshwick Bay, Port Erin, and elsewhere in that neighbourhood, almost always on *Corallina officinalis*.

Byerley (*loc. cit.*) records it at Hilbre Island, among sea-weed and sponge. We have found it in great abundance under stones at low water spring-tides at Llandudno and Beaumaris; and, more sparingly, in deep water in the Menai Straits, from Puffin Island to Menai Bridge.

*Ophiocoma nigra*, Abildgaard (sp).

*Asterias nigra*, Abildgaard in Müll., *Zool. Dan.*, pl. 93, 1789.

*Ophiocoma nigra*, Müll. and Tr., *Wieg. Archiv*, p. 328, 1840; *Ast.*, p. 100. Lyman, *Ill. Cat. Mus. Comp. Zool.*, No. 1, p. 81; *Syst.* Ludwig, *Anatomie der Ophiuren*, *Zeits. für Wissen. Zoologie*, vol. xxxi, p. 241.

*Ophiocoma granulata*, Forbes, *British Star Fishes*, p. 50.

*Ophiocoma Nilsonii*, Müll. and Tr., *Syst. Ast.*, p. 100, 1842.

Specimens of this species were dredged in August, from

* Forbes *A History of British Star Fishes.*

depths varying from ten to twenty fathoms, off Spanish Head, and from Port St. Mary to Calf, Isle of Man, bottom chiefly Nullipore and gravel.

*Ophiothrix pentaphyllum*, Pennant (sp).

*Asterias pentaphyllum*, Pennant, *Brit. Zool.*, vol. iv, pp. 54, 55, 1812.

*Ophiothrix pentaphyllum*, Ljungman, Dr. Goës, *Oph. Öf. Kong. Akad.*, p. 622.; Lyman, *Bull. Mus. Comp. Zool.*, vol. iii, part x, p. 249.

*Ophiocoma rosula*, Forbes, *British Star Fishes*, p. 60.

From a depth of fourteen fathoms, in the Sound between Puffin Island and Penmon, Anglesea, the dredge was brought up several times during the cruise of the "Hyæna," completely filled with specimens of this species. It was also obtained opposite Bangor, on May 24th. During August, it was found to occur in great numbers off Spanish Head and Port St. Mary, Isle of Man, at depths varying from ten to twenty fathoms; bottom chiefly Nullipore and gravel; and at low-water mark in Douglas Bay. It was also found at Penmaenmawr, in July. Byerley (*loc. cit.*) records it as occurring plentifully at Hilbre Island. We have found it in large numbers under stones and among the roots of *Laminaria* at low water spring-tides at Beaumaris, and in deep water at several points between that town and Puffin Island.

# REPORT on the VERMES of the L. M. B. C. DISTRICT.

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## Introduction.

The Vermes collected by the Liverpool Marine Biology Committee during the summer of 1885 form a fairly representative series of types of all the main groups. The Chætopoda, are especially well represented, numbering no less than thirty-seven out of the total number of forty-two species collected. Some of these are particularly interesting, not only as having been found here now for the first time, but also as having been observed only very rarely around our coast. Most of the Tubicolous Annelides are, however, common forms.

The classification I have adopted is that of Claus; * in the nomenclature of species I have followed McIntosh in his Monographs † on the various groups of British Vermes and his "Challenger" Report. I desire specially to acknowledge my indebtedness to Dr. McIntosh, F.R.S., for the uniform kindness with which he has answered many questions with regard to the identification of species with which I had difficulty.

Of the more important additions to our Fauna, as recorded by Byerley, the following seem worthy of special mention:—*Carinella linearis* among the Nemertea; *Lagisca propinqua, Harmothoë haliæti, Malmgrenia castanea, Iphione muricata, Hermadion assimile, Sthenelais zetlandica, Spio-*

* *Traité de Zoologie*, 1884.

† "Monograph on British Nemerteans," *Ray Soc.*, 1874. *Trans. Zool. Soc.*, vol, 9. *Trans. Roy Soc.*, *Ed.* 1868–69. "Report on the Annelida," '*Chall.*' *Exp. Repts.*

*chætopterus typicus*, *Thelepus circinatus*, *Dasychone lucullana*, *Filograna implexa*, *Protula protensa*, among the Polychæta.

A few observations, more especially on the Polychæta of the collection, form a distinct paper.

## Class.—Platyelmia.

### Order IV. — NEMERTEA.

### Sub-order.—ANOPLA.

#### Family.—Malacobdellidæ.

*Malacobdella grossa*, O. F. Müller.

A fine specimen of *Malacobdella grossa* was obtained parasitic in the shell of a live *Cyprina islandica*, which was found on Lavan Sands, Llanfairfechan.

#### Family.—Lineidæ.

*Carinella linearis*, Montagu.

An example of this species was dredged off Port Erin, Isle of Man. In colour, form, and anatomical features it agreed entirely with Montagu's description, as also with McIntosh's notes in his Ray Society Monograph on the Nemertea. The specimen was of a brick red colour, with white bands, when living, but after preservation in alcohol was of a yellowish white colour, the pale bands and annulations being pure white. Only about 1½ in. of the worm was preserved, and that fragment tended to break into segments at the white annulations.

*Lineus marinus*, Montagu.

A specimen of this species was obtained in Bay Fine, Isle of Man, coiled around the dredge and its contents. The bottom was composed of stones and loose seaweed. A specimen was also found by Mr. R. D. Darbishire on the beach, east of Beaumaris.

This is the *Borlasia nigra* of Byerley's list.

*Borlasia octoculata*, Johnston.

*Lineus sanguineus*, Rathke.

Recorded by Byerley as having been found by Mr. Weightman on oysters.

## Class.—Nematelmia.

### Order.—CHÆTOGNATHA.

*Sagitta bipunctata*, Quoy and Gaimard.

This form was found in abundance by tow-netting off Port Erin. During July and August it seems to have occurred in greatest quantity when the water was rather rough and while a strong breeze was blowing. It does not occur in Byerley's list.

## Class.—Gephyrea.

### Order.—CHÆTIFERA.

*Thalassema* sp. (?).

One specimen of a species apparently belonging to the genus *Thalassema* was obtained at the entrance to the Menai Straits on the "Hyæna" expedition. The body had a length of 10 mm., while the sheath of the proboscis measured 25 mm. The sheath was grooved and, though swollen at the end, not bifurcated. The body was smooth posteriorly, but bore two spines anteriorly, ventrally placed and recurved. The alimentary canal was coiled, but the anus was terminal. I have not been able to make out as yet whether the species is one already described, and postpone further observations till I have investigated that point.

## Class.—Annelida.

### Sub-class.—Hirudinea.

#### Family.—Rhynchobdellidæ.

*Pontobdella muricata*, Linnæus.

Found by Mr. Darbishire on skates at Southport, and also at Penmaenmawr.

## Sub-class.—Chætopoda.

## Order.—OLIGOCHÆTA.

### Family.—Lumbricidæ.

*Lumbricus lineatus*, Müller.

Two small worms which I refer doubtfully to this species, were found in mud, in a dredging obtained off Hilbre Id., in company with *Sabellaria alveolata*. They were unmistakably Oligochæta of the genus *Lumbricus*, but I am doubtful as to the species. Carrington * mentions *L. lineatus* as being found in mud at Southport, though "very rare," so that the probability is that the examples obtained by the L.M.B.C. are not far off the form mentioned. Carrington also records *L. capitatus*, John., and *L. pellucidus*, Flem.

## Order.—POLYCHÆTA.

### Section A.—ERRANTIA.

### Family. — Aphroditidæ.

*Hermione hystrix*, Savigny.

Two specimens of this form were obtained, one on a gravelly bottom at a depth of fifteen fathoms, half way between Port Erin and the Calf, Isle of Man, and one on a bottom composed of Nullipores, in twenty fathoms water, off Spanish Head, near Port St. Mary, Isle of Man. It does not occur in Byerley's list. It is noted as occurring at the Channel Islands, on the S. English coast, in the Mediterranean, and at St. Vincent. It is figured by McIntosh in his Report on the "Challenger" Annelides (pl. viii, fig. 3). *Hermione hystrix*, under the generic name of *Aphrodite*, is mentioned by Forbes † as having been found at the Isle of Man and S. Wales.

* "Polychæta of the Southport Shore." *Proc. Manch. Lit. and Phil.*, 1865.

† *British Assoc. Report*, 1850.

*Aphrodite aculeata*, Linnæus.

Mentioned by Byerley as having been found "once at Leasowe, and rarely on other parts of the shore;" and by Forbes (*loc. cit.*), as having been taken at the Isle of Man, and also by Carrington on the Southport sands. A specimen of *A. aculeata* was dredged by the L. M. B. C. in the Channel between Puffin Island and Anglesea. It has also been frequently brought for the Liverpool Museum Aquaria by Liverpool fishermen; and used to be found occasionally at Egremont, and on the Bootle shore, by the Museum Collector, Mr. Wood.

Family.—POLYNOIDÆ.

*Lagisca propinqua*, Malmgren.

One specimen of this species was obtained in Hilbre Swash, from a depth of four fathoms. The specimen was in a rather mutilated condition, but the characteristic markings on the spines, the scales, the dark spots at the bases of the feet, and the absence of the tentacle proved its identity with Malmgren's species, corresponding with McIntosh's figures.* The colouring of the head region did not agree with McIntosh's description, but the colour is not of much specific value.

The species does not occur in Byerley's list; it is mentioned, however, by McIntosh as having been found at St. Andrews and Shetland.

*Harmothoë lunulata*, Delle Chiaje.

*Polynoë maculosa*, Carrington, *Proc. Manch. Lit. Phil. Soc.*, 1865.

This species is described by McIntosh (*loc. cit.*) and by Carrington (*loc. cit.*), in detail.

*Acholoë astericola*, Delle Chiaje.

*Polynoë asterinæ*, Carrington, *Proc. Manch. Lit. and Phil*, 1865.

This species is described both by McIntosh and Carring-

* *Trans. Zool. Soc.*, vol. ix, p. 376, pl. lxvii, 12.

ton; by the latter as being found commensal on *Astropecten irregularis* (*Asterias aurantiaca* of Forbes) from Southport.

*Harmothoë haliæti*, McIntosh.

This species was first dredged in fifty-three fathoms in the Minch by Dr. Gwyn Jeffreys, and afterwards during the "Knight Errant" Expedition in the Faroë Channel. McIntosh describes and figures the species in the *Trans. Zool. Soc.* (*loc. cit.*), and the body and scales in the "Challenger" Report (p. 96). Unfortunately the scales in the specimen obtained by the L. M. B. C. were absent; the spines, position of the eyes, and cirri, however, agree with McIntosh's account. The specimen was found at Port Erin, Isle of Man, in about fifteen fathoms water. It was about 20 mm. in length. It is not recorded by Byerley.

*Harmothoë imbricata*, Linnæus.

A large number of examples of this form were found under stones, and on rocks and loose stones, covered with seaweed, and also abundantly in rock pools. They were most plentiful at low water-mark. Most of the specimens were obtained at Bay ny Carrickey, between Port St. Mary and Poyllvaaish, Isle of Man. A few were also obtained from Hilbre and the Anglesea coast. Probably this is the *Polynoë cirrata* of Byerley's and Carrington's lists. The latter mentions them as "very rare"; that may, no doubt, be explained by their preferring a rocky shore.

*Malmgrenia castanea*, McIntosh.

This rather rare species, which has not been previously recorded as having been observed on this coast, was found as a commensal in the ambulacral groove of *Astropecten irregularis*, between the rows of pedicels. The head of the worm was level with the peristome. It has been dredged by Gwyn Jeffreys off North Unst, Shetland, in ninety to ninety-six fathoms, in 1867, and again in 1868, as a commensal near

the mouth of *Spatangus purpureus*, from a depth of eighty-five fathoms, and a shell-sand bottom. He also obtained it in eighty fathoms off Valentia, in a hundred and ten fathoms off Blasquet, and in the Channel Islands (McIntosh, *Trans. Zool. Soc., loc. cit.*) The two specimens obtained by the L. M. B. C. were dredged with their host from a depth of fourteen fathoms from a sandy bottom, six miles north of the Great Ormes Head. The species is fully described but not figured (save the spines) by McIntosh (*loc. cit.*)*

*Iphione muricata*, Savigny.

One specimen of this species was obtained from the Beaumaris shore. It was very large, but all the scales were unfortunately removed. There was, however, no difficulty in including it under Savigny's species, with which it agreed in the structure of the head, spines, and cirri. McIntosh, in the Report on the "Challenger" Annelida, describes this form, which he contrasts with *Iphione cimex*, collected on that expedition. Savigny describes and figures *Iphione muricata.*†

*Polynoë floccosa*, Savigny.

One large and two small specimens of this *Polynoë* were found along with *Harmothoë imbricata* at Bay ny Carrickey. It is a common form round our coast, and is described and the spines figured in the *Trans. Zool. Soc.* (*loc. cit.*), by McIntosh. It is not recorded by Byerley.

*Polynoë squamata*, Linnæus.

A number of examples of *Polynoë squamata* were found on the shore at Hilbre, and also in dredgings in eight fathoms in Hilbre Swash from a gravel bottom. One small specimen was obtained at Port St. Mary, Isle of Man. Byerley mentions it as having been found at Hilbre and at New Brighton.

* *Syst. des Annél.*, p. 21 and pl. iii, fig. 1.

† Vid. *Notes on some of the Polychæta of the L.M.B.C. District Report I.*

The species is worked out in detail by Bourne. *

Carrington (*loc. cit.*) mentions two varieties of this form, both of which occur in the collection of the L. M. B. C. The markings on the scales are, however, very variable.

*Hermadion assimile*, McIntosh.

This form was first found by McIntosh at St. Andrews, and afterwards (according to that author) " on the west coast of Ireland, south of England, and off the Spanish coast in the 'Porcupine' expedition." The species is described by McIntosh in *Trans. Zool. Soc.* (*loc. cit.*) Two examples were found by the L. M. B. C. They were coiled round the peristome of *Echinus esculentus* hidden by the peristomial spines. The *Echinus* was dredged from a gravel bottom, in ten fathoms water, at Bay Fine, near Port Erin, Isle of Man. The species has not been previously recorded from this coast. Most of the scales fell off so soon as the animal was removed from the *Echinus*, otherwise both examples were very perfect and agreed entirely with the characters of the species as laid down by McIntosh.†

FAMILY.—SIGALIONIDÆ.

*Sthenelais zetlandica*, McIntosh.

This form, first dredged by Gwyn Jeffreys, off Shetland, was met with near Port Erin. One specimen only, was obtained in the dredge, in twenty fathoms of water. The example from which McIntosh described the species was a fragmentary one, the anterior region being injured and the head absent. His description of those parts which he was able to observe tallies, however, with the specimen obtained at Port Erin. The head was absent also in the Port Erin specimen, and from the length of the fragments obtained one being over 80 mm. long), after having been for some

* *Trans. Linn. Soc.*, 1883.

† Vid. *Notes on some of the Polychæta of the L.M.B.C. District Report I.*

months in spirit), the complete animal appears to be of considerable dimensions.

*Pholoë minuta*, Fabricius.

*Pholoë inornata*, Johns.

Mentioned by Carrington * as having been very rarely found on the sands at Southport. It was not found by the L. M. B. C., although, it is true, comparatively little shore work was done on the expeditions.

*Sigalion* sp. (?).

Carrington (*loc. cit.*), describes a *Sigalion* as having been found at Southport (*Sigalion Carringtonii*, C. H. Brown), which does not however seem to be recognised by subsequent authors.

Family.—Nepthyidæ.

*Nepthys longisetosa*, Oersted.

*Nepthys hombergii*, Aud. & M. Edw.

One specimen of this form was dredged off Hilbre Island. It is a native of the Mediterranean and the North Sea, and has been found at Hilbre, and recorded by Byerley under the synonym of *Nepthys hombergii.*

A small fragment of a worm, which was, by its spines, referred to this species, was obtained at Port Erin.

Carrington records *N. hombergii*, from Southport Sands.

*Nepthys margaritacea*, Sars.

Recorded by Carrington from Southport.

Family.—Phyllodocidæ.

*Eulalia viridis*, O. F. Müller.

A small specimen of this species was obtained in the "Hyæna" Expedition, off Great Ormes Head. The proboscis was very long and fully everted. The specimen

* *Proc. Manch. Lit. and Phil.*, 1865.

seems to have been young, and the spines were small and in various stages of development. This is probably the *Phyllodoce viridis* of Byerley's list.

*Phyllodoce lamelligera,* Johnston.
*Phyllodoce vittata,* Ehlers.
*Phyllodoce attenuata,* Carrington.
*Phyllodoce clava,* Carrington.

These species are all recorded by Carrington as having been found by him on the sands at Southport. Probably his *P. clava* is *P. clavigera* (of Aud. and Ed.). *P. attenuata* seems to be only a variety of *P. lamelligera.* None of these were however obtained by the L. M. B. C., probably for the reason already assigned, viz., that no systematic shore exploration has yet been organised.

### Family.—Syllidæ.

*Syllis armillaris,* O. F. Müller.

Three specimens were obtained in the dredge in eleven to thirteen fathoms north of Puffin Island, on the Anglesea coast. It is mentioned by Byerley as being rare on this coast.

*Syllis prolifera,* Müller.

Mentioned by Carrington as "abundant in wet places, but covered by a stratum of mud, and hence, as also from its minute size, easily overlooked."

*Pollicita peripatus,* Johnston.

Carrington says, "Several specimens were found at the base of *Alcyonium digitatum* brought from deep water after storms."

*Syllis noctiluca,* Savigny.

This form was found by Dr. Edwards, and recorded by Byerley, from the mud at the Landing Stage, Liverpool. It

has probably been exterminated during the formation of the new stage.

*Myrianida fasciata*, M.-Edwards.

Found at Hilbre by Byerley, but not observed since.

Family.—NEREIDÆ.

*Nereis pelagica*, Linnæus.

Abundant at Hilbre and the coast generally; also at Puffin Island, Anglesea, and Penmaenmawr. Some large specimens were obtained at Port St. Mary, Isle of Man. It is probably the *Nereis margaritacea* of Byerley's list.

*Nereis viridis*, Linnæus.

This species was also obtained from Port St. Mary, Isle of Man. Byerley mentions it, but does not specify the locality.

Both this species and *N. pelagica*, are recorded by Carrington from Southport.

*Nereis brevimana*, Johnston.

*Nereis margaritacea*, Leach.

*Nereis dumerillii*, Aud. and M.-Edw.

*Nereis bilineata*, Johnston.

These species are all recorded by Carrington as having been found in refuse of fishing-boats, &c., at Southport.

Family.—LUMBRICONEREIDÆ.

*Lumbriconereis fragilis*, O. F. Müller.

One specimen of this species was obtained from Port St. Mary, Isle of Man, and fragments of three or more from Puffin Island, Anglesea. It is described by Müller as being common in the North Sea, and was found during the "Porcupine" expedition, in fifty-three fathoms, near the island of Rona.

Family.—EUNICIDÆ.

*Eunice* sp. (?)

One or two fragments of Annelides were obtained from

Port St. Mary, Isle of Man, which from their general appearance and from the structure of the spines were obviously to be referred to the genus *Eunice*, but the species could not be made out with certainty.

### Family.—Goniadidæ.

*Goniada maculata*, Johns.

This species is recorded by Carrington from Southport, but neither that, nor the following one, was collected by the L. M. B. C.

*Goniada alcockiania*, Carrington.

This species has not been included by more recent writers on the Annelida. If identical with a previously-named species, I have not been able to discover its synonym.

### Family.—Glyceridæ.

*Glycera alba*, Müller.

Mentioned by Carrington (*loc. cit.*), as having been found by him "among the tufts of *Antennularia antennina.*"

## Section B,—SEDENTARIA.

### Family.—Opheliadæ.

*Ophelia coarctata*, M.-Edw.

Recorded by Carrington from Southport.

### Family.—Mæadæ.

*Mæa mirabilis*, Johnston.

A rare Annelid, first described by Johnston, and found by Carrington at Southport.

### Family.—Chætopteridæ.

*Spiochætopterus typicus*, Sars.

A large example of this species was found at low water at Beaumaris. The specimen inhabited a pergamentaceous tube

which was buried in shingly sand. The specimens obtained in the "Porcupine" Expedition, were dredged from five hundred fathoms. McIntosh however, remarks that the species found by the "Challenger," were all shallow water forms.

### Family.—Spionidæ.

No members of this family were found by the L. M. B. C., but the following species are recorded by Dr. Carrington, from Southport:—

*Spio seticornis*, Fabricius. Probably this is the *Spio crenaticornis* of Montagu.

*Spio quadricornis*, Lamarck.

*Nerine vulgaris*, Johnston (doubtfully).

*Nerine coniocephala*, Johnston.

### Family.—Telethusidæ.

*Arenicola piscatorum*, Lamarck.

Everywhere abundant, and used for bait along the coast, from the Dee estuary northwards.

### Family.—Cirratulidæ.

*Cirratulus borealis*, Lamarck.

Very abundant on the Cheshire coast. A large number of species were obtained also at various places on the coast, near Port St. Mary and Port Erin, Isle of Man, under stones, in mud, and amongst decaying Algæ.

*Cirratulus cirratus*, O. F. Müller.

One specimen was dredged off Port St. Mary, Isle of Man, but was in a rather mutilated condition. It has not been recorded before from this locality.

### Family.—Hermellidæ.

*Sabellaria alveolata*, Savigny.

*Sabellaria anglica*, Grube.

The tubes of this species form great encrusting masses

at Hilbre and other places on the coast. Tubes were also dredged in Hilbre Swash, and trawled in eight fathoms water off the Great Ormes Head. Very large beds are also to be found near the Lighthouse, at Fleetwood. Its geological significance has been referred to by Herdman.*

It is recorded by Byerley as being very abundant at New Brighton, Caldy Blacks, and Hilbre.

Carrington also mentions it under the synonym of *S. anglica*, as being parasitic on the whelk and other shells.

*Sabellaria crassissima*, Lamarck.

"Rare" (Carrington).

*Sabella unispira*, Savigny (?).

The worm recorded as *Sabellaria unispira* by Byerley, is probably *Sabella unispira* of Savigny, and as such is marked "a doubtful species" in the *Brit. Assoc. List*, 1860, and does not appear in subsequent lists.

Family.— AMPHICTENIDÆ.

*Pectinaria belgica*, Pallas.

Recorded by Carrington.

This species was dredged in six to seven fathoms on a sandy bottom from the west end of Constable Bank, Llandudno; from a gravel bottom in twenty fathoms at Port Erin, Isle of Man; and at low water, in great abundance, on Waterloo shore.

*Pectinaria auricoma*, O. F. Müller.

This is the *Amphitrite auricoma* of Byerley's list.

These two forms seem to be in want of re-description in order to decide whether there are any real points of distinction.† Many empty tubes were obtained which might have belonged to this species, but no live forms were obtained in the collection of the L. M. B. C.

* *Proc. Geol. Soc. Liverpool*, Sess. 1884–5.

† See separate Paper on this subject further on in this volume.

*Ops*, spp. (?).

Carrington describes two new species of a genus *Ops*. I am in some doubt as to the name as the genus does not seem to be recognised by more recent investigators.

*Amphitrite ventilabrum*, Riss.

Mentioned by Byerley as often confounded with *A. (Pectinaria) auricoma*.

No example was dredged by the L. M. B. C. *Sabella ventilabrum* of Carringtón's list is probably the same form.

### Family.—Chloræmidæ

*Siphonostomum gelatinosum*,

Dr. Herdman informs me that he found and identified an example of this species at Hilbre, on July 11th, 1885. The worm was unfortunately not preserved.

### Family.—Terebellidæ.

*Terebella conchilega*, Pallas.

This common form was obtained plentifully at Hilbre. It is recorded by Byerley and by Carrington as having been found generally about the shore. A number of specimens were also obtained from Port Erin, Isle of Man.

*Terebella crysodon*, Montagu.

*Terebella coustrictor*, Montagu.

These forms are mentioned by Carrington, but were not found by the L. M. B. C.

*Terebella nebulosa*, Grube.

Found abundantly in the dredge off Port Erin, Isle of Man, its muddy tubes coiled in the interior of large lamellibranch shells, &c.

Recorded from Hilbre by Byerley.

*Thelepus circinatus*, Fabricius.

One specimen of this form was obtained from Penmaen-

mawr. The species was dredged by the "Knight Errant" off the north coast of Scotland in 1880. It does not appear in Byerley's list.

Family.—SABELLIDÆ.

*Sabella penicillus*, Linnæus.

*Sabella pavonia*, Savigny.

One very large specimen and a few smaller ones were obtained, the former in the dredge off the Great Ormes Head, the latter at Hilbre. It is not recorded by Byerley.

*Dasychone lucullana*, Delle Chiaje.

Two specimens of the animal were obtained, but no tubes. They were dredged off Puffin Island, on the Anglesea coast, from a depth of twelve fathoms. It does not occur in Byerley's list.

Family.—SERPULIDÆ.

*Serpula vermicularis*, Linnæus.

This species, the common *Serpula*, is found abundantly over rocks and shells on the coast. Specimens were obtained from Hilbre, and plentifully at the Isle of Man. It occurs in Byerley's list.

*Serpula triquetra*, Linnæus.

This form was obtained at Penmaenmawr, and is recorded by Carrington, and by Byerley, under the synonym of *Vermilia triquetra*.

*Spirorbis borealis*, Davidson.

*Spirorbis communis*, Fleming.

This Serpulid is very abundant on the seaweed, stones, &c. on the shore. Some very fine specimens were found encrusting *Corallina officinalis*, at Fleshwick Bay, Isle of Man. Mentioned by Carrington under the synomyn *S. communis*.

*Spirorbis lucidus*, Montagu.

*Spirorbis minutus*, Montagu.

Both mentioned by Carrington. *S. lucidus* is recorded by Byerley.

Byerley also mentions *S. nautiloides* and *S. rugosa*. I have not been able to discover for what these names are synonyms; neither specific name occurs in any list of *Spirorbes* that I am acquainted with.

*Filograna implexa*, Berkeley.

This species was obtained at low water, between Port St. Mary and Spanish Head, Isle of Man, attached to the roots of *Laminaria*. It is not recorded by Byerley.

*Protula protensa*, Grube.

A number of tubes of this form were dredged between Port St. Mary and Spanish Head, Isle of Man, depth, twenty fathoms. No animals were found however, in the tubes, and they have been referred to this species doubtfully. It has not been recorded by Byerley, but was dredged during the "Porcupine" expedition, in five to thirty fathoms, north of the Island of Rona.

——— ——— (?).

Certain tubes of small size forming an irregular mass were dredged at Port Erin, Isle of Man. No inhabitants were found in the tubes. They are leathery, and resemble some Annelid tubes. Dr. McIntosh, F.R.S., to whom I referred the matter, gives it as his opinion that they are the tubes of a Crustacean, probably a species of *Cerapus*, but thinks it unsafe to dogmatise.

### Family.—TOMOPTERIDÆ.

*Tomopteris onisciformis*, Eschscholtz.

Young specimens of this form were found in the tow-net off Port Erin, Isle of Man, on August 7th, 1885. This is the common *Tomopteris* of the British seas, and does not call for more detailed notice. It is not recorded by Byerley.

# REPORT on the POLYZOA of the L. M. B. C. DISTRICT.

By Joseph Lomas,

Associate of the Normal School of Science.

## Introduction.

In the autumn of 1751, a collection of Sea-plants and Corallines, gathered from the shores of Anglesey and Ireland, was sent to a London merchant named Ellis.

He disposed of this material "on thin boards covered with clean white paper, in such a manner as to form a kind of landscape, making use of two or three sorts of *Ulva marina* or Sea-Liverwort, of different colours, in designing a variety of hills, dales, and rocks, which made proper ground-work and keeping for the little trees, which the expanded Sea-plants and Corallines not unaptly represented." *

Her Royal Highness the Princess Dowager of Wales was pleased to accept some of these landscapes from Mr. Ellis, and, in order to get a greater variety, he collected specimens from other localities.

While examining and arranging this material by means of a microscope "in order to distinguish their proper characters with the greater accuracy," he soon discovered "that they differed not less from each other, in respect to their form, than they did in regard to their texture; and that, in many of them, this texture was such, as seemed to indicate their being more of an animal than vegetable nature." †

Peysonnel, a French physician, had made this discovery

* Ellis, *Corall.*, *Introd.*, p. v. † *Ibid.* p. vi.

some time before, but he was discredited, and the leading naturalists of the day stoutly opposed his views.

In 1755, Ellis published an *Essay towards a Natural History of the Corallines*, in which he described and figured the forms he believed to be animals. Considering the means of observation at his command, the illustrations strike us with wonder on account of their marvellous accuracy.

Among the Corallines, he described a considerable number of Polyzoa, so I think we can fairly claim that Ellis was the first one to work at this group of animals in our neighbourhood.

Since that time other eminent naturalists have been attracted to this field of labour. Notable amongst these I may mention Prof. E. Forbes, F.R.S., and the Rev. Thos. Hincks, B.A., F.R.S., whose invaluable work on the *British Marine Polyzoa* has furnished a great portion of the material for this report.

The whole of our district, however, has not been thoroughly examined, for while the Isle of Man, the coast of North Wales, and the neighbourhood of Hilbre Island have been the favourite resorts of collectors, the coast of Lancashire, particularly the part extending from Liverpool to Blackpool, seems to have been almost untouched.

Up to the present I have been able to record ninety-eight species occurring in our area, divided among the four great groups as follows:—

| | |
|---|---|
| Cheilostomatous forms | 66. |
| Cyclostomatous forms | 13. |
| Ctenostomatous forms | 17. |
| Entoproctous forms | 2. |

One species I insert with considerable hesitancy—viz., *Membranipora flemingii*. In the *British Marine Polyzoa* it is described as "common, and generally distributed on our coasts," but no special localities are given. But as we could

not expect to get all the common forms even, as the result of one season's labour, we may hope for additions to our lists as the results of further search.

I have followed mainly the classification of Mr. Hincks, as laid down in the *British Marine Polyzoa*, with a few alterations rendered necessary by the researches of Prof. Lankester.*

In conclusion, I must express my gratitude to the Rev. Thos. Hincks, B.A., F.R.S., whose valuable help in determining species, about which I was in doubt, has always been very willingly given; to Mr. Quelch, B.Sc., of the Natural History Museum, South Kensington, for kindly placing the National Collection at my disposal for reference, and also for kindly advice and help in naming the specimens; and to Professor Herdman, D.Sc., whose valuable assistance, amid pressing avocations, has always been most readily accorded me.

## Class.—POLYZOA. J. V. Thompson.

Syn. *Bryozoa.* Ehrenberg, &c.
*Tentaculibranchia.* E. Ray Lankester.

## Section.—Eupolyzoa. E. R. Lankester.

### Sub-Class.—Ectoprocta. Nitsche.

### Order.—GYMNOLŒMATA. Allman.

Syn. *Polyzoa infundibulata* Busk, *B. M. Cat.*

### Sub-order. I.—CHEILOSTOMATA. Busk.

Syn. *Cellporina.* Ehrenberg.

### Family I.—Aeteidæ.

### Genus *Aetea*, Lamouroux.

Only three species of *Aetea* have been found in British Seas, and they are all represented in our area.

* *Ency. Brit.*, 9th edit.; article "Polyzoa."

*Aetea anguina*, Linnaeus.

*Anguinaria spatulata*, Lamk., *An. s. Vert.* (ed. 2) ii, 196. Busk, *Trans. Micr Soc.* for 1849, 123. pl. i, figs. 7, 8. Johnston, *B. Z.*, (ed. 2), 290, pl. i. figs. 7, 8.

Found in great abundance on Hydrozoans cast up on shore at West Kirby (Lomas); also occurs at Ramsay, Isle of Man, and Llandudno (Hincks). Holyhead (Higgins).

*Aetea recta*, Hincks.

*Hippothoa sica*, Johnston, *B. Z.* (ed. 2) 292.

Smitt (*Œfvers K. Vet-akad, Förhandl*, 1867), regards this as a variety of *A. anguina.*

Occurs in the Isle of Man (Hincks). Dredged in considerable abundance by Professor Herdman, off Port Erin, (ten to fifteen fathoms).

*Aetea truncata*, Landsborough.

*Anguinaria truncata*, Landsb. (*Pop. Hist. Brit. Zooph.*, 288).

Common in the Isle of Man, on oyster-shells (Hincks). Erect and composite forms near Port Erin (ten to fifteen fathoms), on sea-weed.

### Family II.—Eucratiidæ.

### Genus *Eucratea*, Lamouroux.

Syn. *Sertularia* (part). Linn.
*Scruparia*, Busk.

Only two species have been described belonging to this genus, *E. ambigua*, D'Orb., a native of South America, and *E. chelata*, abundant in Australia and Europe.

*Eucratea chelata*, Linn.

*Scruparia chelata*, Busk, *B. M. Cat*, i, 29.

In the *British Marine Polyzoa* Mr. Hincks describes two varieties of this species :—

Var. *α. repens.* Zooecia decumbent and adnate; aper-

ture scarcely marginate, branches given off from the sides of the cells (B. M. P., plate v, fig. 8).

Var. *β. gracilis*. Zooecia very slender and elongate, tubular below and enlarged above.

While examining the material dredged by Professor Herdman last summer about the south-west coast of the Isle of Man, I came across some forms of this species which were very much more elongated than the forms described and figured in the B. M. P.

This character held for a great number of specimens, and it may be well to class them as a distinct variety, (γ) *elongata*, of which I give a figure. (See Plate III, fig. 1.)

Var. *α. repens* was dredged by Mr. Hincks off the Maughold Head, near Ramsey, "where it is common, and spreads in rather large dendritic patches over oysters and other shells."

Bangor, Rhyl (Shrubsole). Beaumaris (Walker). Holyhead (Higgin).

### Genus *Gemellaria*, Savigny.

Syn. *Orisia* (sp.) Lamx., Lamk.

This genus only includes one British species.

*Gemellaria loricata*, Linn.

*Gemellaria loricata*, Johnston, *B. Z.*; Alder.
*Cellaria loriculata*, Ellis & Sol.; Lamk.

Found in great abundance on the Lancashire coast at Lytham, &c. Llandudno (Hincks). Rhyl (Shrubsole). Puffin Island (Walker). Hilbre I. (Lomas).

Dredged in the "Merry Andrew" Expedition (May 9th), (ten to eleven fathoms), at Hilbre Swash.

## Family III.—Cellulariidæ.

Syn. *Cellularidæ*. (part). Johnst., *Brit. Zooph.*
*Cellulariadæ*, Busk, *B. M. Cat.*
*Cabereadæ*, *id. ibid.*
*Cellularieæ* (part), Smitt.

Genus. *Cellularia*, Pallas.

Only one British member of this genus.

*Cellularia peachii*, Busk.

*Cellularia neritina*, var., Johnston.

Given as occurring near Liverpool, by Byerley.

Genus. *Scrupocellaria*, Van Beneden.

Syn. *Cellularia*, Pall., Johnst., Smitt.
*Canda*, Busk.

This genus forms a large group, and is widely distributed. About twenty species are known. Found sparingly in northern latitudes, but more common in southern seas. Five British species.

*Scrupocellaria scruposa*, Linn.

*Cellularia scruposa*, Pall., Flem., Johnst., Smitt.

Generally distributed around our coasts (Hincks). Isle of Man. Penmaenmawr (Lomas). Hilbre Island (Rev. H. H. Higgins). Colwyn Bay (Shrubsole, Walker). Holyhead (Higgin).

*Scrupocellaria scrupea*, Busk.

Found on shore at West Kirby (Lomas), and dredged off Port Erin (five to ten fathoms), by Professor Herdman; and in the "Merry Andrew" Expedition, at Hilbre Swash (ten to eleven fathoms). North Wales (Shrubsole). Not previously recorded in this district.

*Scrupocellaria reptans*, Linn.

*Cellularia reptans*, Pall, Johnston, Smitt.
*Canda reptans*, Busk, *B. M. Cat*

Very common. Isle of Man, on *Pecten* and *Laminaria*; Penmaenmawr, West Kirky, &c. Colwyn Bay and Beaumaris (Walker). Holyhead (Higgin).

Family IV.—BICELLARIIDÆ.

Syn. *Bicellarieæ*. Smitt.

### Genus *Bicellaria*, Blainville.

Syn. *Cellularia*. Pallas (part), Flem., Johnst.
*Crisia* (part) Lam., Van Ben.

Confined to Australian Seas, except two British forms, *B. ciliata* and *B. alderi* (N. Scotland).

*Bicellaria ciliata*, Linn.

*Cellularia ciliata*, Pall., Flem., Johnst.
*Crisia ciliata*, Lam., Van Ben.

Fleetwood, on a buoy; Menai Straits (Hincks). West Kirby, on Algæ, abundant. Hilbre (Lomas). Bangor and Southport (Pennington). Rhyl (Shrubsole). New Brighton (Marrat). Bootle (Tudor). Colwyn Bay (Walker). Holyhead (Higgin).

### Genus *Bugula*, Oken.

Syn. *Cellularia*, Pall., Johnst.
*Bugulina*, Gray.
*Avicularia*, J. V. Thompson, Gray.

Very widely distributed. Eight British species are known.

*Bugula turbinata*, Alder.

Dredged off Gt. Orme's Head; Isle of Man (Hincks); Menai Straits (Alder); Hilbre Island, in great abundance (Lomas). Colwyn Bay (Shrubsole).

*Bugula flabellata*, J. V. Thompson.

*Flustra avicularis*, J. Sowerby, Flem., Johnst.
*Bugula avicularia*, Smitt.

On *Flustra*, Isle of Man (Lomas); Bootle (Tudor); Llandudno, N.W. (Hincks); West Kirby (Lomas); Menai Straits (Pennington); Seacombe (Marrat). Colwyn Bay (Shrubsole).

Dredged during the "Hyæna" Expedition.

*Bugula avicularia*, Linn.

*Sertularia avicularia*, Linn.
*Cellularia avicularia*, Landsb., &c.

Blackpool (Pennington); Hilbre Island (Byerley); Colwyn Bay (Shrubsole). Holyhead (Higgin).

*Bugula plumosa*, Pallas.

*Crisia plumosa*, Lamx.
*Crisularia plumosa*, Gray, *B. M. Cat.*, Rad. iii.
*Cellularia plumosa*, Pallas, Couch.

Found at Fleetwood on a buoy (Hincks.)

Very beautiful specimens have been dredged during the summer off Penmaenmawr by Mr. Thompson, and off Port Erin by Prof. Herdman; Menai Straits (Pennington), Bootle Shore and Hilbre (Marrat).

*Bugula purpurotincta*, Norman.

*Cellularia plumosa*, Johnst., *B. Z.*, Sars.
*Bugula fastigiata*, Alder, *Cat. Zooph.*, *North and Durham*, 59.
*Bugula avicularia forma fastigiata*, Smitt.

Menai Straits (Hincks).

This is a northern form, and Menai Straits is the most southern locality yet noted.

Genus *Beania*, Johnst.

Only one British representative.

*Beania mirabilis*, Johnston.

Found on weed, Isle of Man (Hincks).

Dredged by Prof. Herdman off Port Erin (five to ten fathoms).

Family V.—Notamiidæ.

With single representative *Notamia bursaria*, Linn., not found in our area.

Family VI.—Cellariidæ.

Syn. *Escharidæ* (part), Johnst.
*Salicornaridæ*, Busk.
*Cellarieæ*, Smitt.

Genus *Cellaria*, Lamouroux (part).

*Salicornaria*, Cuvier, Johnst., Busk.
*Farcimia*, Fleming.

This genus ranges from New Zealand and Tasmania to Spitzbergen, and geologically as far back as the Cretaceous epoch.

It was obtained during the "Challenger" expedition at depths from 2,000 to 3,000 fathoms. Three British species.

*Cellaria fistulosa*, Linn.

*Salicornaria salicornia*, Cuvier.
*Farcimia fistulosa*, Flem.
*Salicornaria farciminoides*, Johnst., Busk, Reuss.

Hincks (*Brit. Mar. Poly.*, 106) gives no less than twenty-four synonyms which have been applied to this species.

Generally distributed. Dredged in large quantities in the Isle of Man by Prof. Herdman off Spanish Head (twenty fathoms). Colwyn Bay (Shrubsole). Isle of Man (twenty-five fathoms) (Forbes). Holyhead (Higgin).

This species is met with at great depths, being found on the Falmouth and Lisbon Cable at 89 to 205 fathoms (Sir James Anderson).

Family VII.—Flustridæ.

Syn. *Escharidæ* (part), Johnst., Pall.
*Flustradæ* (part), Busk.

Genus *Flustra*, Linn.

Syn. *Eschara* (part), Pallas, Linn.
*Flustra* sp., Linn., Lamk., Johnst., Busk, Smitt.
*Carbasea*, Gray, Busk.

Universally distributed. Most abundant in northern latitudes. Five British species.

*Flustra foliacea*, Linn.

*Eschara foliacea*, Linn, Ell. and Sol., Lamk., Van Ben.

Found everywhere. Very abundant at Hilbre Island, West Kirby, New Brighton, Holyhead, Isle of Man, &c., at low-water mark.

*Flustra papyracea*, Ellis and Sol.

*Flustra chartacea*, Couch, Johnst.

Hilbre, very scarce (Byerley).

*Flustra carbasea*, Ellis and Solander.

*Carbasea papyracea*, Gray, *Bt. M. Cat.*
*Carbasea Papyrea*, Busk, *B. M. Cat.*, Alder.

Bootle, rare (Tudor).

*Flustra securifrons*, Pallas.

*Narrow-leaved hornwrack*, Ellis.
*Eschara securifrons*, Pallas.
*Flustra truncata*, Linn., Lamk., Flem., Johnst., Busk.

Chiefly a northern form. Rhyl (Shrubsole). Not previously recorded.

Family VIII.—Membraniporidæ.

Syn. *Celleporidæ*, Johnst.

Genus *Membranipora*, Blainville.

Syn. *Flustra* (part), Linn, Lamk., Flem., Lam.

Has a wide range both in space and time, ranging to the Cretaceous epoch. 23 British species.

*Membranipora lacroixii*, Audouin.

*Biflustra lacroixii*, Smitt., Flor., Bryoz.
*Membranipora membranacea*, Johnst.
*Flustra lacroixii*, Savigny.

Ramsey, Isle of Man, on stones in tide-pools (Hincks). Altcar and New Brighton on *Buccinum* (Lomas). Colwyn Bay (Shrubsole).

*Membranipora monostachys*, Busk.

*Membranipora pilosa forma Monostachys*, Smitt.

Dredged on a stone in Liverpool Bay, by Professor Herdman. Not previously recorded in this district.

*Membranipora catenularia*, Jameson.

*Hippothoa catenularia*, Flem., Johnst., Busk.

Isle of Man, dredged by Prof. Herdman. Not previously recorded in our district.

*Membranipora pilosa*, Linnæus.

*Flustra pilosa*, Linn, Lamk., Flem.
*Annulipora dentata*, Gray.

This species is found everywhere, and is the most abundant form met with in our seas.

The masses of sea-weed left by the tide at high-water mark are frequently found covered with it.

On Sertularians, it usually has the appearance of a brown hairy covering, but when found on *Laminaria*, or red Algæ, it forms a beautiful silvery crust.

*Membranipora membranacea*, Linn.

*Flustra membranacea*, Linn., Ellis and Sol., Johnst., &c.

Found mostly on *Fuci*, and is very generally distributed. (Byerley). North Wales (Shrubsole). Hilbre (Marrat). It is remarkable that this species, which is regarded as a very common one, was not once met with among the specimens collected during the present season.

*Membranipora hexagona*, Busk.

*Flustra coriacea*, Johnst.

Found on shells and stones. Only a few localities have been recorded where this species occurs, viz. :—Isle of Man on *Pecten opercularis* (E. Forbes), and on the coast of Devon (Miss Cutler), Peterhead (Peach).

*Membranipora lineata*, Linnæus.

*Flustra lineata*, Linn., Johnst.
*Callopora lineata*, Gray.

Common in the Isle of Man. Forms rounded patches on *Laminaria*.

*Membranipora craticula*, Alder.

*Flustra lineata*, Couch.
*Membranipora lineata forma craticula*, Smitt.

Very abundant on shells dredged off Maughold Head, Isle of Man (Hincks).

*Membranipora spinifera*, Johnston.

*Flustra lineata* (part), Johnston.

Isle of Man, between tide marks (Hincks).

*Membranipora flemingii*, Busk.

*Membranipora membranacea* (part), Johnst.

Common, and widely distributed (Hincks).

*Membranipora dumerilii*, Audouin.

*Membranipora membranacea* (part), Johnst.
*Membranipora flemingii*, Busk, *B. M. Cat.*
*Membranipora pouilletii*, Alder. Busk, *Crag Polyzoa.*

Isle of Man (Hincks).

*Membranipora rosselii*, Audouin.

*Flustra rosselii*, Aud., Savigny.

Off Maughold Head, Isle of Man (Hincks).

*Membranipora aurita*, Hincks.

Found on a piece of wood near Spanish Head, Isle of Man. Not previously found in our area, and the only other localities are Devon and Cornwall (Hincks), Antrim (Hyndman), Northumberland (Alder), and Brighton on flints (Lomas).

Family IX.—MICROPORIDÆ.

*Membraniporidæ* (part), Busk.

Genus *Micropora*, Gray.

Syn. *Discopora* (part), Lamarck.
*Membranipora* (part), Busk

Two British species.

*Micropora coriacea*, Esper.

*Flustra coriacea*, Esper.
*Membranipora coriacea*, Busk, *B.M Cat.* ii.

Isle of Man (Forbes).

Family X.—CRIBRILINIDÆ.

Syn. *Escharidæ* (part), Johnston.
*Membraniporidæ* (part), Busk.
*Eschariporidæ* (part), Smitt.

Genus *Cribrilina*, Gray.

Syn. *Lepralia* (part), Johnst., Busk.
*Escharipora*, Smitt.

Five British species.

*Cribrilina radiata*, Moll.

*Lepralia innominata*, Couch., Johnst., Busk., &c.

A Mediterranean form, abundant on south and south-west coasts of England, ranging to Isle of Man (Hincks).

*Cribrilina punctata*, Hassall.

*Lepralia punctata*, Has., Johnst., Busk.

Isle of Man (Hincks).

Found on wood near Spanish Head, Isle of Man.

The punctures are very large, and arranged regularly, forming a beautiful network over the front of the cell.

*Cribrilina annulata*, Fabricius.

*Lepralia annulata*, Johnst., Busk.

Isle of Man, rare (Hincks).

Genus *Membraniporella* (part), Smitt.

Syn. *Lepralia* (part), Johnst. and Gray, Busk., &c.
*Membranipora* (part), Smitt.
*Berenicea* (part), Fleming.

Two British species. *M. melolontha* has not been observed in our area. It is found on shells, oysters mostly, at the mouths of rivers, as the Thames, Orwell, etc.

*Membraniporella nitida*, Johnston.

*Lepralia nitida*, Johnst., Couch., Busk, Hincks, Smitt.
*Escharoides nitida*, M. Edw.

Isle of Man (E. Forbes); on *Pecten*, off Spanish Head, Isle of Man (twenty fathoms), dredged by Prof. Herdman.

Family XI.—MICROPORELLIDÆ.

Syn. *Celleporidæ* (part), Johnst.
*Membraniporidæ* (part), Busk.
*Porinidæ* (part), d'Orbigny.
*Eschariporidæ* (part), Smitt

Genus *Microporella*, Hincks.

Syn. *Porina*, Smitt
*Escharina* (part), Gray, M. Edwards.

All the four British species are found in our area.

*Microporella ciliata*, Pallas.

*Lepralia personata*, Busk.
*Lepralia ciliata*, Johnst, Busk.
*Porina ciliata*, Smitt.

Isle of Man (Hincks).

*Microporella malusii*, Audouin.

*Herentia biforis*, Gray.
*Lepralia malusii*, Busk, &c.
*Porina malusii*, Smitt.

Isle of Man (Hincks). Dredged off Spanish Head (Isle of Man), on *Pecten* (twenty fathoms), by Prof. Herdman.

*Microporella impressa*, Audouin.

*Flustra impressa*, Aud., Sav
*Lepralia granifera*, Johnst., Busk.

Isle of Man (Hincks).

*Microporella violacea*, Johnston.

*Lepralia violacea*, Johnst, Busk, &c.
*Porina violacea*, Smitt.

Isle of Man (E. Forbes).

Genus *Chorizopora*, Hincks.

Syn. *Flustra* (sp.), Audouin.
*Lepralia* (sp.), Johnst, Busk.

Only one British representative.

*Chorizopora brongniartii*, Audouin.

*Lepralia brongniartii*, Busk.

Isle of Man (Hincks).

Family XII.—PORINIDAE.

Not found in Liverpool Bay.

Family XIII.—MYRIOZOIDÆ.

Syn. *Celleporidæ* (part), Johnst.
*Membraniporidæ*, Busk.

Genus *Schizoporella*, Hincks.

Syn. *Lepralia* (part), Johnston, Busk, &c.

This genus has eighteen British species.

*Schizoporella spinifera*, Johnst.

*Lepralia ciliata*, Hass. and Couch.
*Lepralia spinifera*, Johnst., Busk (in part).

Llandudno (Hincks), and Isle of Man, off Port Erin, dredged by Prof. Herdman (ten to fifteen fathoms).

*Schizoporella auriculata*, Hassall.

*Lepralia auriculata*, Hass., Johnst., Busk.
*Escharella auriculata*, Smitt.

Isle of Man (Hincks).

*Schizoporella hyalina*, Linnæus.

*Cellepora hyalina*, Linn., Fabr.
*Lepralia hyalina*, W. Thomp., Johnst., Busk
*Mollia hyalina*, Smitt.

Found in considerable abundance in the Isle of Man on *Laminaria* (Hincks). Also on the telson of *Homarus vulgaris* brought into Liverpool market (Lomas).

*Schizoporella linearis*, Hassall.

*Lepralia linearis*, Hass., Johnst., Busk, Norman, &c.
*Lepralia hastata*, Hincks, *Dev. and Corn. Cat*
*Herentia linearis*, Gray.
*Escharella linearis*, Smitt.

Very abundant and generally distributed (Hincks). Colwyn Bay (Shrubsole).

Genus *Hippothoa*, Lamouroux.

Syn. *Catenicella* (part), Blainville.
*Mollia* (part), Smitt.

Contains three British species and one doubtful one, *H. cassiterides*, Couch.

*Hippothoa distans*, MacGillivray.

*Hippothoa flagellum*, Manzoni, Hincks.

Isle of Man.

In Hincks' *British Marine Polyzoa* (1880), this is described as *H. flagellum*; but in *A. M. N. H.* for July, 1881, the name is withdrawn in favour of the above.

*Hippothoa divaricata*, Lamouroux.

*Mollia hyalina forma divaricata*, Smitt.

Generally distributed (Hincks). Colwyn Bay (Shrubsole).

## Family XIV.—Escharidæ.

Syn. *Celleporidæ* (part), Johnst.
*Escharidæ* (part), Busk.
*Membraniporidæ* (part), Busk.

### Genus *Lepralia*, Johnston (part).

Syn. *Eschara* (part), Auctt.

Contains eight British species.

*Lepralia pallasiana*, Moll.

*Cellepora pallasiana*, Lamx.
*Lepralia pediostoma*, Johnst.

Llandudno; Isle of Man, common (Hincks).

*Lepralia foliacea*, Ellis and Solander.

*Eschara retiformis*, Ray, d'Orb.
*Stony foliaceous coralline*, Ellis.
*Millepora foliacea*, Ellis and Sol.

Isle of Man (Dr. Brown); Holyhead (Higgin).

*Lepralia pertusa*, Esper.

*Cellepora pertusa*, Esper.
*Cellepora perlacea*, W. Thomp.
*Escharella pertusa*, Smitt.

Isle of Man (E. Forbes).

### Genus *Umbonula*, Hincks.

Syn *Lepralia* (part), Johnst.
*Discopora* (part), Gray.
*Eschara* (part), Smitt.

Only one British species.

*Umbonula verrucosa*, Esper.

*Cellepora verrucosa*, Esp.
*Lepralia verrucosa*, W. Thomp, Johnst, Busk, &c.

Dredged by Prof. Herdman off Port St. Mary (Isle of

Man), also found on wood near Spanish Head. Not previously recorded in this locality.

Genus *Porella*, Gray.

Syn. *Cellepora* (part), Fleming.
*Eschara* (part), Sars., Busk, Alder, Smitt, &c.
*Hemeschara* (part), Norman, &c.

Contains five British species.

*Porella concinna*, Busk.

*Lepralia concinna*, Busk, Hincks.
*Porella lævis*, Smitt.
*Lepralia belli*, Dawson.

Isle of Man (Hincks).

*Porella compressa*, Sowerby.

*Millepora compressa*, Sow.
*Cellepora cervicornis*, Flem., Johnst., Couch, Busk, Alder.
*Eschara cervicornis*, Busk, Hincks, Smitt, &c.

Dredged off Spanish Head, 20 fathoms, by Professor Herdman. Very fine specimen, not previously recorded.

Genus *Smittia*, Hincks.

Syn. *Eschara* (part), Auctt.
*Lepralia* (part), Johnst., Busk, &c.

Seven British species.

*Smittia landsborovii*, Johnston.

*Lepralia Landsborovii*, Johnst., Busk, Hincks.
*Eschara Landsborovii*, Alder.
*Lepralia crystallina*, Norman.

Found off the Great Orme's Head (erect form) (Hincks), and on a piece of wood from the Isle of Man.

*Smittia reticulata*, Macgillivray.

*Lepralia reticula*, Macgill., Johnst., Busk, &c.

Dredged by Prof. Herdman off Spanish Head, Isle of Man (twenty fathoms), on *Pecten*. Not previously recorded in this district.

*Smittia trispinosa*, Johnston.

*Discopora trispinosa*, Johnst.
*Lepralia trispinosa*, Johnst., Busk, Hincks.
*Escharella jacotini*, Smitt.

Isle of Man (Hincks).

Genus *Phylactella*, Hincks.

Syn. *Lepralia* (part), auctt.
*Alysidota* (sp.), Busk.

Three British species.

*Phylactella collaris*, Norman.

*Lepralia collaris*, Norman.

Isle of Man (Hincks.

Genus *Mucronella*, Hincks.

Syn. *Lepralia* (part), Johnst., Busk, &c.
*Escharella*, Gray.
*Discopora*, Smitt.

Eight British species.

*Mucronella peachii*, Johnston.

*Lepralia peachii*, Johnst, Gray, Busk.
*Escharella immersa*, Gray.

Dredged off Spanish Head (Isle of Man), on *Pecten*, by Prof. Herdman. Not previously recorded in this district.

*Mucronella variolosa*, Johnston.

*Lepralia variolosa*, Johnst., Couch, Busk.

Found encrusting *Mytilus edulis* at Ramsey, Isle of Man. Not previously recorded.

*Mucronella coccinea*, Abildgaard.

*Cellepora coccinea*, Abildgaard.
*Lepralia coccinea*, Johnst., Busk.
*Lepralia mamillata*, Searles Wood, Busk, Manzoni.

Dredged by Prof. Herdman off Spanish Head, on *Pecten*, and off Port St. Mary, on *Laminaria* roots. Also found on *Anomia* (five fathoms). Very common in the Isle of Man.

### Family XV.—Celleporidæ.

Syn. *Escharidæ* (part), d'Orb.
*Myriozoidæ* (part), Smitt.

### Genus *Cellepora* (part), Fabricius.

Syn. *Tubipora* (part), Linn.
*Millepora*, Ellis and Sol.
*Madrepora* (part), Esper.

Seven British species.

*Cellepora pumicosa*, Linnæus.
*Porous Eschara*, Ellis.

Common; very large and beautiful specimens are found encrusting shells, sea-weeds, &c., in the Isle of Man, Ramsey, West Kirby, Hilbre (Lomas); Holyhead (Higgin).

Welshman's Gut, " Spindrift " Expedition.

*Cellepora costazii*, Audouin.
*Cellepora bimucronata*, Hass.
*Cellepora hassallii*, Busk, Manzoni.
*Celleporaria hassallii*, Smitt.

Isle of Man, Ramsey, and Point of Ayr (Hincks).

Dredged in the deep hole off the Point of Ayr (N. Wales), in the " Spindrift " Expedition.

## Sub-order II.—CYCLOSTOMATA, Busk.

Syn. *Tubuliporina*. Milne-Edwards, Johnston.

### Group *a*.—Radicellata, d'Orbigny.

Syn. *Articulata s. radicata*, Busk (1859), *Crag Polyzoa*.

### Family I.—Crisiidæ.

### Genus *Crisia* (part), Lamouroux.

Syn. *Sertularia* (part). Linn.

Three British species, all found in our area.

*Crisia cornuta*, Linn.

*Crisidia cornuta*, M. Ed., Johnst., Busk.

Found almost everywhere in our area. Llandudno, Isle of Man (Hincks); West Kirby, var. *geniculata* (Lomas); Menai Straits (Pennington); Holyhead (Higgin).

*Crisia eburnea*, Linn.

*Crisia aculeata*, Hassall, Johnst.

Isle of Man. Dredged on *Pecten* off Spanish Head (ten to fifteen fathoms) by Prof. Herdman; Blackpool, Menai Straits (Pennington). Found in a deep hole off the Point of Ayr in the "Spindrift" Expedition. Colwyn Bay (Shrubsole); Holyhead (Higgin).

*Crisia denticulata*, Lamarck.

*Cellaria denticulata*, Lamk.
*Crisia luxata*, Flem., &c.

Very generally distributed (Hincks).

Isle of Man (Lomas); Leasowe (Higgins).

Group *b*. Incrustata, d'Orbigny.

Syn. *Inarticulata*, Busk.

Family II.—TUBULIPORIDÆ.

Genus *Stomatopora*.

Contains twelve British species.

*Stomatopora expansa*, Hincks.

Found on dead shells in the Isle of Man (Hincks). Not recorded in any other locality.

*Stomatopora major*, Johnston.

*Alecto repens*, Wood, Busk.
*Alecto major*, Johnst., Busk.

Isle of Man, in deep water (Hincks).

Genus *Tubulipora*, Lamarck.

Three British species.

*Tubulipora lobulata*, Hassall.

Extremely abundant off Maughold Head, Isle of Man (Hincks).

Ramsey Bay, on *Mytilus* (Lomas).

*Tubulipora flabellaris*, Fabricius.

*Tubipora flabellaris*, Fabr.
*Tubulipora phalangea*, Couch, Johnst., Hincks, Busk.

Colwyn Bay (Shrubsole). Not previously recorded in our district.

Genus *Idmonea*, Lamouroux.

Syn. *Tubulipora*, Lamk
*Tubulipora*, subgenus *Idmonea*, Smitt.

Two British species.

*Idmonea serpens*, Linn.

*Tubipora serpens*, Linn., &c.
*Millepora tubulosa*, Ellis and Sol.
*Tubulipora serpens*, Flem., Johnst., Busk, &c.

Generally distributed. Extremely abundant on the shore at West Kirby, on *Hydrallmania falcata* (Lomas). The specimens were collected from among the masses of sea weed left by the tide at high water mark, and they differ considerably from those forms which are found on shells and stones, &c. This species affords a good example of the changes which a form may undergo when placed under varying influences. The same form also dredged in the Welshman's Gut (seven fathoms), and Hilbre Swash, "Merry Andrew" expedition (ten to eleven fathoms). Seacombe (Byerley). Colwyn Bay (Walker); Holyhead (Higgin).

Genus *Diastopora*, Lamouroux.

Syn. *Tubulipora* (sp.) Johnst., &c.
*Patinella* (sp.) Busk, Hincks.

Four British species.

*Diastopora patina*, Lamarck.

*Tubulipora patina*, Lamk., Johnst.
*Patinella patina*, Busk.

Found on *Pecten* dredged by Prof. Herdman off Spanish Head, Isle of Man (twenty fathoms). Holyhead (Higgin).

Also found by Mrs. Beever.

*Diastopora suborbicularis.*

*Diastopora simplex*, Busk, *Crag Pol.*; Smitt.
*Diastopora obelia*, Johnst.

Found in Isle of Man (Hincks).

*Diastopora obelia*, Johnst.

*Tubulipora obelia*, Johnst.

Generally distributed on our coasts (Hincks). Rhyl (Shrubsole). Anglesea, fourteen fathoms (Forbes).

Family III.—Hornerid*æ*.

Not represented in our area.

Family IV.—Lichenoporidæ.

Genus *Lichenopora*, Defrance.

Syn. *Discoporella*. Gray, Busk, Smitt.
*Tubulipora* (part), Johnst.
*Heteroporella* (sp.) Hincks.

Four British species.

*Lichenopora hispida*, Fleming.

*Tubulipora hispida*, Johnst.
*Discoporella hispida*, Gray, Busk, Smitt, Sars., Alder, &c.

Found in the Isle of Man (Hincks). Dredged by Prof. Herdman off Spanish Head (twenty fathoms) on *Pecten*.

*Lichenopora verrucaria*, Fabricius.

*Madrepora verrucaria*, Fabr., Linn.
*Discoporella verrucaria*, Smitt., Busk.

Rhyl (Shrubsole). This is a northern form, and it has not been recorded so far south before.

## Sub-order III.—CTENOSTOMATA, Busk.

Syn. *Halcyonellea* and *Vesicularina*, Johnston.

### Group *a*. Halcyonellea, Ehrenberg.

Syn. *Alcyonidulæ*, Johnst., *Brit. Zooph.*, edit. 1.
*Polyzoa carnosa*, Gray.

### Family I.—Alcyonidiidæ.

Syn. *Alcyonidulæ*, Couch.
*Halcyonellea*, Smitt.

### Genus *Alcyonidium*, Lamouroux.

Syn. *Alcyonium* (part), Linn, Pallas, &c.
*Cycloum*, (sp.), Hassall.

Nine British species.

*Alcyonidium gelatinosum*, Linnæus.

Sea ragged staff, Ellis.
*Alcyonium gelatinosum*, Linn., Pallas, Ellis and Sol., Lamx., &c.

This species is very abundant in our district, and grows to an enormous size.

Isle of Man and Llandudno (Hincks). Dredged in the "Hyena" Expedition in the Menai Straits opposite Bangor, and in a deep hole off the Point of Air in the "Spindrift" Expedition. Hilbre (Marrat).

*Alcyonidium hirsutum*, Fleming.

*Alcyonium hirsutum*, Flem.
*Cycloum papillosum*, Hassall, Johnst., Byerley, &c.

Isle of Man, Llandudno, Menai Straits (Hincks). Dredged off Port Erin (ten to fifteen fathoms) by Prof. Herdman, and by Mr. Thompson off Penmaenmawr.

*Alcyonidium mytili*, Dalyell.

Syn. *Alcyonidium hexagonum*, Hincks, Alder
*Alcyonidium parasiticum*, Smitt.

Llandudno. Isle of Man, common. Menai Straits (Hincks).

*Alcyonidium parasiticum*, Fleming.

*Alcyonium parasiticum*, Flem., Blainv.

Menai Straits (Hincks). Liverpool Bay (Higgins). North Wales (Shrubsole).

### Family II.—Flustrellidæ.

Syn. *Halcyonellea* (part), Smitt.

#### Genus *Flustrella*, Gray.

Syn. *Flustra* (part), Flem., Blainv., Johnst., Couch., Hincks, &c.
*Alcyonidium* (part), Smitt.

Only one British species.

*Flustrella hispida*, Fabricius.

*Flustra hispida*, Fabr., Flem., &c.
*Alcyonidium hispidum*, Johnst., Smitt, &c.
*Cycloum hispidum*, W. Thomp.

Common and widely distributed.

Dredged in the summer by Mr. Thompson off Penmaenmawr. Colwyn Bay (Shrubsole); Hilbre, Isle of Man, &c.

### Family III.—Arachnidiidæ.

Syn. *Alcyonidiadæ* (part), Hincks, 1862; Alder.

#### Genus *Arachnidium*, Hincks.

Syn. *Arachnidia*, Hincks, Alder.

This Genus contains three British forms.

*Arachnidium hippothooides*, Hincks.

*Arachnidia hippothooides*, Hincks.

On a *Cyprina*, dredged off the Isle of Man (Hincks).

Only one other locality, Torbay, is known where this form occurs.

### Group *b*. Stolonifera, Ehlers.

Syn. *Vesicularina*. Johnst.

Section I.—*Orthonemida*, Hincks.

### Family IV.—Vesiculariidæ.

### Genus *Vesicularia* (part). J. V. Thompson.

Syn. *Sertularia*, Linn , Pallas, &c
*Valkeria*, Flem., &c.

Only contains one British species.

*Vesicularia spinosa*, Linnæus.

Silk coralline, Ellis.
*Sertularia spinosa*, Linn., Ellis and Sol., Lamk.

This species is very common in our area.

Menai Straits, Llandudno, Lytham, Isle of Man (Hincks). Liverpool (Landsborough). Blackpool (Pennington). Hilbre and New Brighton (Marrat). Colwyn Bay (Walker).

Dredged in large quantities in fourteen fathoms about six miles from Great Orme's Head, in the "Hyæna" expedition.

### Genus *Amathia*, Lamouroux.

Syn. *Sertularia* (part), Linn, &c.
*Serialaria*, Lamk. (1816), Flem., Johnst., &c.

Only one British species.

*Amathia lendigera*, Linnæus.

*Nit coralline*, Ellis.
*Sertularia lendigera*, Linn., Pall., &c.
*Serialaria lendigera*, Lamk., Johnst., Couch, Landsb., Alder, &c.

Very common.

Llandudno, Menai Straits, Isle of Man (Hincks); Penmaenmawr, dredged by Mr. Thompson; Blackpool (Pennington); West Kirby, on shore (Lomas); Puffin Island and Hilbre Island (Marrat); Beaumaris (Walker); Anglesea (Forbes); Holyhead (Higgin).

Dredged in Hilbre Swash, "Merry Andrew" Expedition (ten to eleven fathoms), and in the hole off Point of Air, "Spindrift" Expedition.

Genus *Bowerbankia*, Farre.

Syn. *Valkeria* (part), Johnst., Hassall, Couch.

Contains five British species.

*Bowerbankia imbricata*, Adams.

*Sertularia imbricata*, Adams, Thomp.
*Valkeria imbricata*, Johnst., Couch.

Very common. Dredged off Port Erin, by Professor Herdman (ten to fifteen fathoms). Hilbre Island (Lomas). Menai Straits (Pennington).

*Bowerbankia pustulosa*, Ellis and Sol.

*Dichotomous tubular coralline*, Ell.
*Sertularia pustulosa*, Ellis and Sol.
*Vesicularia pustulosa*, J. V. Thomps.
*Valkeria pustulosa*, Johnst.

Menai Straits. Llandudno (Hincks). Isle of Man, dredged by Professor Herdman.

Genus *Farrella*, Ehrenberg.

Syn. *Lagenella*, Farre, W. Thompson, Hassall.
*Laguncula*, Van Ben.

Only has one British represe tative.

*Farrella repens*, Farre.

*Lagenella repens*, Farre, W. Thomp.
*Bowerbankia repens*, Johnst.
*Farrella producta*, Hincks.

There are two varieties of this species, *repens* and *elongata*.

In the *British Marine Polyzoa*, p. 530, Hincks says:—"As to the distribution of the species, it is somewhat peculiar that the *elongata* form, which is too remarkable readily to escape observation, has only been noticed on certain portions of the Lancashire coast, where it occurs in amazing profusion, investing all kinds of marine substances."

Form *elongata.* Fleetwood, on
extremely abundant (Hincks).

### Family V.—Buskiidæ.

Syn. *Vesicularidæ* Alder.

### Genus *Buskia,* Alder.

Only one British species.

*Buskia nitens,* Alder.
Llandudno (Hincks).

### Family VI.—Cylindrœciidæ.

Syn. *Vesiculariadæ* part), Busk, Alder, Hincks.

### Genus *Cylindræcium,* Hincks.

Syn. *Farrella* (part), Busk. Gosse, Hincks.
*Avenella,* Alder, Hincks, Gosse.

Contains three British species.

*Cylindrœcium dilatatum,* Hincks.
*Farrella dilatata,* Hincks.
*Farrella fusca,* Busk.

Llandudno; Isle of Man (Hincks).
Dredged off Port Erin (ten to fifteen fathoms) by Prof. Herdman.

### Genus *Anguinella,* Van Beneden.

Only one British species.

*Anguinella palmata,* Van Beneden.
Hilbre Island (Herdman).

### Family VII.—Triticellidæ.

Not yet found in our district.

Section II.—*Campylonemida*, Hincks.

### Family VIII.—Valkeriidæ.

Syn. *Vesiculariadæ* (part), Johnst., Alder.

### Genus *Valkeria* (part), Fleming.

Syn. *Sertularia* (part), Linn., Pallas, &c.
*Vesicularia* (part), J. V. Thompson, Smitt.
*Campylonema*, Hincks.

Contains two British species.

*Valkeria uva*, Linnæus.

*Repent form.* Grape Coraline. Ellis.
*Sertularia uva*, Linn., Ellis and Sol.
*Erect form.* Climbing dodder-like Coralline, Ellis.
*Sertularia cuscuta*, Linn., Pall., Lamx, &c.

Form *uva*. Menai Straits, on larger *Fuci*, in immense quantity (Hincks).

Form *cuscuta*. Landudno. Menai Straits, on larger *Fuci* (Hincks). Isle of Man, dredged by Professor Herdman.

*Valkeria tremula*, Hincks.

*Campylonema tremulum*, Hincks.

Dredged off the Isle of Man (Hincks).

### Family IX.—Mimosellidæ.

Genus *Mimosella*, Hincks.

Only one British representative.

*Mimosella gracilis*, Hincks.

*Valkeria cuscuta*, Couch.

Dredged by Prof. Herdman off the Isle of Man, between Port Erin and the Calf (ten to fifteen fathoms). Not previously recorded.

### Family X.—Victorellidæ, Saville Kent.

Not found in our area. This family only contains one species, *Victorella pavida*, a brackish and fresh water form, which has been found in the Victoria Docks, London, and

recently in the Regent's Canal by Mr. Bousfield. Probably a good search in our estuary and docks might lead to its discovery.

## Sub-class II.—Entoprocta, Nitsche.

### Order.—PEDICELLINEA.

The only order.

### Family I.—Pedicellinidæ.

Syn. *Pedicellinæ*, Johnston.

### Genus *Pedicellina, Sars.*

Syn. *Hydra* (part), Bosc, Blainville.

Contains three British representatives.

*Pedicellina cernua*, Pallas.

" Fleshy Polypes of a red colour and a particular kind." Ellis.
*Pedicellina echinata*, Sars., Hassall, Smitt, &c.
*Pedicellina belgica*, Gosse, Hincks.

Both the smooth and spinose varieties of this species are common in the Isle of Man (Lomas).

*Pedicellina gracilis*, Sars.

Isle of Man; Fleetwood, on a buoy; Llandudno (Hincks).

Dredged by Prof. Herdman between Port Erin and the Calf (ten to fifteen fathoms).

Var. *nodosa*, nov. (Pl. III, fig. 2).

Among the material dredged in the Isle of Man, I found the form which Hincks describes as having the stem " very much elongated, and consists of several sections separated by knots or swellings, which are also muscular in character." At first I thought it was *P. belgica*, Van Beneden, which is characterised by a swelling in the stem, but on separating the stolon from the sea weed on which it was growing, I discovered that on the same stolon there was the ordinary form without the medial swelling. The swelling in *P. belgica*, moreover, is gradual, while in this form it is abrupt and sharply defined from the rest of the stem.

The stems are arranged alternately, with great regularity on opposite sides of the stolon. There is a swelling at the junction of the stolon with the stem-basal cylinder of Hincks, which, in this case, is wider than in the one figured in B. M. P., and the muscular substance is continued for a little distance on each side into the stolon. Then about the middle of the stem is another swelling, and just under the head a third, which is constricted so as to have the appearance of two swellings, both muscular, and the lower one rather less than the upper one. It is easy to see that these swellings would be of great use to the creature in giving it a variety of movements in order to search for food and to retreat in face of danger.

It is possible that the individual without the medial swelling may be an imperfectly developed form so far as the stem is concerned. How the median swelling has been formed I do not know, but it is quite possible that the head swelling may be converted into the median one by an elongation of the stem above it. I am the more inclined to this view since, in some individuals, there is a short stem between the uppermost swelling and the head, and the part of the stem above the median swelling varies much in size, while the part between the base and middle swelling is pretty constant (Pl. III, fig 2).

There is little doubt, I think, that it should be referred to *P. gracilis*, yet the characters mentioned above show it to be a well marked and very aberrent variety, for which I propose the name, var. *nodosa*.

### Family II.—Loxosomidæ.

Not recorded in our area.

### Explanation of Plate III.

Fig. 1. *Eucratea chelata*, var. *elongata*, nov.

Fig. 2. *Pedicellina gracilis*, var. *nodosa*, nov.

## TABLE SHOWING DISTRIBUTION OF THE SPECIES IN THE DISTRICT.

| Page in Report. | Species. | Cheshire Coast and Hilbre Island. | Welsh Coast, Rhyl to Penmaenmawr. | Menai Straits and Anglesey. | Lancashire Coast, Liverpool to Fleetwood. | Isle of Man. | Remarks. |
|---|---|---|---|---|---|---|---|
| 163 | Sub-Order I.—CHEILOSTOMATA. | | | | | | |
| 163 | Family I.—AETEIDÆ. | | | | | | |
| 163 | *Aetea.* Lamx. | | | | | | |
| 164 | *anguina.* Linn. | + | + | + | | + | |
| 164 | *recta.* Hincks | | | | | + | |
| 164 | *truncata.* Landsb. | | | | | + | |
| 164 | Family II.—EUCRATIIDÆ. | | | | | | |
| 164 | *Eucratea.* Lamx. | | | | | | |
| 164 | *chelata.* Linn. | | + | + | | + | |
| 164 | *α repens* | | | | | + | |
| 165 | *β gracilis* | | | | | + | |
| 165 | *γ elongata* | | | | | + | |
| 165 | *Gemellaria.* Sav. | | | | | | |
| 165 | *loricata.* Linn. | + | + | + | + | | |
| 165 | Family III.—CELLULARIIDÆ. | | | | | | |
| 166 | *Cellularia.* Pallas | | | | | | |
| 166 | *peachii.* Busk | + | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 166 | *Scrupocellaria.* Van Ben. . . | | | | | |
| 166 | *scruposa.* Linn. . . | + | + | + | | + |
| 166 | *scrupea.* Busk . . | + | + | | | + |
| 166 | *reptans.* Linn. . . | + | + | + | | + |
| 166 | Family IV.—BICELLARIIDÆ. | | | | | |
| 167 | *Bicellaria.* Blainville . . | | | | | |
| 167 | *ciliata.* Linn. . . . | + | + | + | + | |
| 167 | *Bugula.* Oken . . . | | | | | |
| 167 | *turbinata.* Alder . . | + | + | + | | + |
| 167 | *flabellata.* J. V. Thomp. . | + | + | + | + | + |
| 168 | *avicularia.* Linn. . . | | + | + | + | |
| 168 | *plumosa.* Pallas . . | + | + | | + | + |
| 168 | *purpurotincta.* Norman . . | | | + | | |
| 168 | *Beania.* Johnston . . | | | | | |
| 168 | *mirabilis.* Johns. . . | | | | | + |
| 168 | Family VI.—CELLARIIDÆ. | | | | | |
| 169 | *Cellaria.* Lamx. . . | | | | | |
| 169 | *fistulosa.* Linn. . . | | + | + | | + |
| 169 | Family VII.—FLUSTRIDÆ. | | | | | |
| 169 | *Flustra.* Linn. . . . | | | | | |
| 170 | *foliacea.* Linn. . . | + | + | + | + | + |
| 170 | *carbasea.* Ellis and Sol. . | | | | + | |
| 170 | *securifrons.* Pall. . . | | + | | | |
| 170 | *papyracea.* Ellis and Sol. . | + | | | | |

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TABLE SHOWING DISTRIBUTION OF THE SPECIES IN THE DISTRICT—*cont.*

| Page in Re-port. | Species. | Cheshire Coast and Hilbre Island. | Welsh Coast, Rhyl to Penmaen-mawr. | Menai Straits and Anglesey. | Lanca-shire Coast, Liverpool to Fleet-wood. | Isle of Man. | Remarks. |
|---|---|---|---|---|---|---|---|
| 170 | Family VIII.—MEMBRANIPORIDÆ. | | | | | | |
| 170 | *Membranipora.* Blainville . . | | | | | | |
| 170 | *lacroixii.* Aud. . . | + | + | | + | + | |
| 171 | *monostachys.* Busk . . | | | | | | On Lobster, brought into Liverpool market, locality doubtful. |
| 171 | *catenularia.* Jameson . . | | | | | + | |
| 171 | *pilosa.* Linn. . . . | + | + | + | + | + | |
| 172 | *flemingii.* Busk. . . | | | | | + | |
| 171 | *hexagona.* Busk . . | | | | | + | |
| 172 | *lineata.* Linn. . . | | | | | + | |
| 172 | *craticula.* Alder . . | | | | | + | |
| 172 | *spinifera.* Johns. . . | | | | | + | |
| 172 | *dumerilii.* Aud. . . | | | | | + | |
| 172 | *rosselii.* Aud. . . . | | | | | + | |
| 172 | *aurita.* Hincks. . . | | | | | + | |
| 171 | *membranacea.* Linn. . . | + | + | | | + | |
| 172 | Family IX.—MICROPORIDÆ. | | | | | | |
| 173 | *Micropora.* Gray . . | | | | | | |
| 173 | *coriacea.* Esper . . | | | | | + | |

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|---|---|---|---|---|---|---|
| 173 | Family X.—CRIBRILINIDÆ. | | | | | |
| 173 | *Cribrilina.* Gray. . | | | | | |
| 173 | *radiata.* Moll. . | | | | | + |
| 173 | *punctata.* Hass. . | | | | | + |
| 173 | *annulata.* Fabr. . | | | | | + |
| 174 | *Membraniporella.* Smitt . | | | | | |
| 174 | *nitida.* Johns. . | | | | | + |
| 174 | Family XI.—MICROPORELLIDÆ. | | | | | |
| 174 | *Microporella.* Hincks . | | | | | |
| 174 | *ciliata.* Pallas . | | | | | + |
| 174 | *malusii.* Aud. . | | | | | + |
| 175 | *impressa.* Aud. . | | | | | + |
| 175 | *violacea.* Johns. . | | | | | + |
| 175 | *Chorizopora.* Hincks . | | | | | |
| 175 | *brongniartii.* Aud. . | | | | | + |
| 175 | Family XIII.—MYRIOZOIDÆ. | | | | | |
| 175 | *Schizoporella.* Hincks . | | | | | |
| 176 | *linearis.* Hass. . | | + | | | |
| 175 | *spinifera.* Johns. . | | + | | | + |
| 176 | *auriculata.* Hassall . | | | | | + |
| 176 | *hyalina.* Linn. . | | | + | | + |
| 176 | *Hippothoa.* Lamx. . | | | | | |
| 176 | *distans.* McGill . | | | + | | + |
| 176 | *divaricata.* Lamx. . | | | + | | |

TABLE SHOWING DISTRIBUTION OF THE SPECIES IN THE DISTRICT—*cont.*

| Page in Report. | Species. | Cheshire Coast and Hilbre Island. | Welsh Coast, Rhyl to Penmaenmawr. | Menai Straits and Anglesey. | Lancashire Coast, Liverpool to Fleetwood. | Isle of Man. | Remarks. |
|---|---|---|---|---|---|---|---|
| 177 | Family XIV.—ESCHARIDÆ. | | | | | | |
| 177 | *Lepralia.* Johns. | | | | | | |
| 177 | *pallasiana.* Moll. | | + | | | + | |
| 177 | *foliacea.* Ellis and Sol. | | | + | | + | |
| 177 | *pertusa.* Esper | | | | | + | |
| 177 | *Umbonula.* Hincks. | | | | | | |
| 177 | *verrucosa.* Esper | | | | | + | |
| 178 | *Porella.* Gray | | | | | | |
| 178 | *concinna.* Busk | | | | | + | |
| 178 | *compressa.* Sow. | | | | | + | |
| 178 | *Smittia.* Hincks | | | | | | |
| 178 | *landsborovii.* Johns. | | + | | | + | |
| 178 | *reticulata.* McGill | | | | | + | |
| 179 | *trispinosa.* Johns. | | | | | + | |
| 179 | *Phylactella.* Hincks | | | | | | |
| 179 | *collaris.* Norman | | | | | + | |
| 179 | *Mucronella.* Hincks | | | | | | |
| 179 | *peachii.* Johns. | | | | | + | |
| 179 | *variolosa.* Johns. | | | | | + | |
| 179 | *coccinea.* Abild. | | | | | + | |

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|---|---|---|---|---|---|---|
| 180 | Family XV.—CELLEPORIDÆ. | | | | | |
| 180 | *Cellepora.* Fab. . . . | | | | | |
| 180 | *pumicosa.* Linn. . . | + | + | + | + | + |
| 180 | *costazii.* Aud. . . | | + | | | + |
| 180 | Sub-Order CYCLOSTOMATA. | | | | | |
| 180 | Family I.—CRISIIDÆ. | | | | | |
| 180 | *Crisia.* Lamx. . . . | | | | | |
| 181 | *cornuta.* Linn. . . | + | + | + | + | + |
| 181 | var. *geniculata* . . | | + | | | + |
| 181 | *eburnea.* Linn. . . | + | + | + | + | + |
| 181 | *denticulata.* Lamk. . . | + | | | | + |
| 181 | Family II.—TUBULIPORIDÆ. | | | | | |
| 181 | *Stomatopora.* Bronn. . . | | | | | |
| 181 | *expansa.* Hincks . . | | | | | + |
| 181 | *major.* Johns. . . | | | | | + |
| 181 | *Tubulipora.* Lamk. . . | | | | | |
| 182 | *lobulata.* Hass. . . | | | | | + |
| 182 | *flabellaris.* Fabr. . . | | + | | | |
| 182 | *Idmonea.* Lamx. . . | | | | | |
| 182 | *serpens.* Linn. . . | + | + | + | | + |
| 182 | *Diastopora.* Lamx. . . | | | | | |
| 183 | *patina.* Lamk. . . | | + | + | | + |
| 183 | *suborbicularis.* Hincks . . | | | | | + |
| 183 | *obelia.* Johnst. . . | | + | + | | |

TABLE SHOWING DISTRIBUTION OF THE SPECIES IN THE DISTRICT—*cont.*

| Page in Report. | Species. | Cheshire Coast and Hilbre Island. | Welsh Coast, Rhyl to Penmaenmawr. | Menai Straits and Anglesey. | Lancashire Coast, Liverpool to Fleetwood. | Isle of Man. | Remarks. |
|---|---|---|---|---|---|---|---|
| 183 | Family IV.—LICHENOPORIDÆ. | | | | | | |
| 183 | *Lichenopora.* Defrance . . | | | | | | |
| 183 | *hispida.* Flem. . . | | | | | | |
| 183 | *verrucaria.* Fabr. . . | | + | | | + | |
| 184 | Sub-Order III.—CTENOSTOMATA. | | | | | | |
| 184 | Family I.—ALCYONIDIIDÆ. | | | | | | |
| 184 | *Alcyonidium.* Lamx. . . | | | | | | |
| 184 | *gelatinosum.* Linn. . . | + | + | + | | + | |
| 184 | *hirsutum.* Flem. . . | + | + | + | | + | |
| 184 | *mytili.* Dal. . . . | | + | + | | + | |
| 185 | *parasiticum.* Flem. . . | + | + | + | | | |
| 185 | Family II.—FLUSTRELLIDÆ. | | | | | | |
| 185 | *Flustrella.* Gray . . | | | | | | |
| 185 | *hispida.* Fabr. . . | + | + | + | | + | |
| 185 | Family III.—ARACHNIDIIDÆ. | | | | | | |
| 185 | *Arachnidium.* Hincks . . | | | | | | |
| 185 | *hippothooides.* Hincks . . | | | | | + | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 186 | Family IV.—VESICULARIIDÆ. | | | | | |
| 186 | *Vesicularia.* J. V. Thomp. | | | | | |
| 186 | *spinosa.* Linn. | + | + | + | + | + |
| 186 | *Amathia.* Lamx. | | | | | |
| 186 | *lendigera.* Linn. | + | + | + | + | + |
| 187 | *Bowerbankia.* Farre | | | | | |
| 187 | *imbricata.* Adams | + | + | + | | + |
| 187 | *pustulosa.* Ellis & Sol. | | + | + | | + |
| 187 | *Farella.* Ehrenberg | | | | | |
| 187 | *repens.* Farre | | | | | |
| 187 | var. *elongata* | | | | + | |
| 188 | Family V.—BUSKIIDÆ. | | | | | |
| 188 | *Buskia.* Alder | | | | | |
| 188 | *nitens.* Alder | | + | | | |
| 188 | Family VI.—CYLINDRŒCIIDÆ. | | | | | |
| 188 | *Cylindrœcium.* Hincks | | | | | |
| 188 | *dilatatum.* Hincks | | + | | | + |
| 188 | *Anguinella.* Van Ben. | | | | | |
| 188 | *palmata.* Van Ben. | + | | | | |
| 189 | Family VIII.—VALKERIIDÆ. | | | | | |
| 189 | *Valkeria.* Flem. | | | | | |
| 189 | *uva.* Linn. | | | | | |
| 189 | form *uva* | | | + | | |
| 189 | form *cuscata* | | + | + | | + |
| 189 | *tremula.* Hincks | | | | | + |

## TABLE SHOWING DISTRIBUTION OF THE SPECIES IN THE DISTRICT—*cont.*

| Page in Report. | Species. | Cheshire Coast and Hilbre Island. | Welsh Coast, Rhyl to Penmaenmawr. | Menai Straits and Anglesey. | Lancashire Coast, Liverpool to Fleetwood. | Isle of Man. | Remarks. |
|---|---|---|---|---|---|---|---|
| 189 | Family IX.—MIMOSELLIDÆ. | | | | | | |
| 189 | *Mimosella.* Hincks | | | | | | |
| 189 | *gracilis.* Hincks | | | | | + | |
| 190 | Sub-Class ENTOPROCTA. | | | | | | |
| 190 | Family I.—PEDICELLINIDÆ. | | | | | | |
| 190 | *Pedicellina.* Sars. | | | | | | |
| 190 | *cernua.* Pall. | | | | | + | |
| 190 | *gracilis.* Sars. | | + | | + | + | |
| 190 | var. *nodosa* | | | | | + | |

# REPORT on the COPEPODA of the L. M. B. C. DISTRICT.

By Isaac C. Thompson, F.R.M.S.

The Copepoda reported upon were collected during the summer of 1885, between May and August inclusive. Many of them were captured during the cruise of the "Hyæna" and on the second Hilbre expedition, and a large number later in the season, off Port Erin, at the south end of the Isle of Man.

It is a remarkable fact that with special opportunities for dredging and tow-netting off Penmaenmawr during July, scarcely any Copepoda were found. Their absence at that time may probably be accounted for by the wide-spread diffusion throughout the sea of the minute gelatinous spherical bodies referred to in the *Report on the Fauna of Penmaenmawr.**

In this connection it is interesting to find that Mr. Pearcey observed, † while conducting tow-netting investigations in the Shetland Seas in the summer of 1884, that in regions where the diatom *Rhizosolenia shrubsolei* was present in great abundance animal life was almost entirely absent in the surface waters.

The strained material from water containing the specimens captured by the tow-net was treated in two different ways for preservation. Firstly, by hardening with a saturated solution of Picric Acid and then with Alcohol; and, secondly, by preserving in a mixture of Glycerine, Alcohol and Water. The former method, though admirable as a preservative of the

* See further on in this Volume.

† "Movements and Food of the Herring," &c., *Proc. Roy. Physical Soc, Edin.*, vol. viii, p. 389, 1885.

tissues, has the disadvantage of destroying any natural colours the animal may have, and it also appears to render the specimens somewhat brittle. Glycerine, besides possessing most valuable preservative qualities itself, has the happy advantage of mixing in any proportion with both alcohol and water, and it has been found that a solution composed as follows—Water 1 part, Proof Spirit 2 parts, and Glycerine 1 part, with 1 per cent. of Carbolic Acid added, is admirably adapted for preserving these small Crustaceans. Any tendency that the glycerine alone might have to dissolve out carbonate of lime is probably counteracted by the addition of the spirit and water.

From either the picric acid and alcohol solution (after washing), or from the glycerine mixture, the objects may without further preparation be at once mounted in Farrant's solution as permanent slides, by which their natural characteristics are maintained intact.

The collection of Copepoda includes nineteen species, of which thirteen are previously unrecorded as belonging to this locality. Three, at least, are altogether new to Britain, and one is possibly an addition to science.

The tow-netting observations made at Port Erin, at various times of the day and evening, do not seem to show any marked variation according to the time; the Copepoda being very much the same in gatherings taken in the middle of the day and after sundown.

My thanks are due to Dr. G. S. Brady, F.R.S., for having kindly examined and identified some of the more difficult specimens, and for additional information in regard to some of the species described in his Ray Society Monograph and "Challenger" Report.*

* A Monograph on the British Copepoda, Ray Society, 1878 and 1880. Report upon the Copepoda collected during the Voyage of H.M.S. 'Challenger,' *Zool. Chall. Exp.*, Part xxiii, 1883.

These works have been followed in the arrangement and nomenclature of the species.

## Order COPEPODA.

### Family I.—Calanidæ.

*Calanus finmarchicus*, Gunner.

*Cetochilus septentrionalis*, Goodsir, *Ed. New Phil. Journ.*, xxxv, p. 339, t. vi, figs. 1–11 (1843).

*Cetochilus septentrionalis*, Baird, *Nat. Hist. Brit. Entom.*, p. 235, t. xxx, figs. 1*a–g* (1850).

Quantities of this species were found in most of the tow-net gatherings taken by Prof. Herdman off Port Erin, at the south end of the Isle of Man, during August. This is probably the most abundant and most widely diffused of all the Copepoda, and it is somewhat singular that it does not occur in any of the tow-net gatherings taken off the Welsh coast or in the neighbourhood of Hilbre Island earlier in the season. It luxuriates in the open sea.

*Pleuromma abdominale*, Lubbock.

*Pleuromma gracile*, Claus.

One female Copepod taken in the tow-net off Port Erin, Isle of Man, in the evening, after sunset, appears to belong to this species, which has not hitherto been found in British seas. The specimen, after having been mounted as a microscope slide, was examined by Dr. Brady, and he has stated that he felt unable to name it positively without dissection, but that it seemed to be new to the British Fauna.

The specimen on a careful examination is found to agree in all essential points with the description and figures Brady gives * of an immature condition of *Pleuromma abdominale* undoubtedly identical with Claus' *Pleuromma gracile*.

* "Challenger" Report, p. 46.

*Metridia armata*, Boeck.

*Paracalanus hibernicus*, Brady and Robertson, *Annals and Mag. of Nat. Hist.*, ser. 4, vol. xii, p. 126, pl. viii, figs. 1–3 (1873).

Found sparingly in the gatherings taken off Port Erin, Isle of Man. All the specimens obtained were males.

*Pseudocalanus elongatus*, Boeck.

*Clausia elongata*, Boeck, *Oversigt Norges Copep.*, p. 10 (1864).

This species occurs in several of Professor Herdman's tow-net gatherings from Port Erin, Isle of Man.

*Candace truncata* (?), Dana.

A few specimens belonging to the genus *Candace* were found among Prof. Herdman's Port Erin gatherings, and were referred to *C. truncata*, a species new to Britain. The chief distinctive feature of the only known British species *C. pectinata* appears to be the presence in the male of a long spine at one side only of the last joint of the thorax; and as all the specimens examined are females, it is just possible they may be *C. pectinata*; they do not, however, exhibit the peculiar shape of abdomen figured by Brady as characteristic of the female of *C. pectinata*. Some more important characteristic by which the females of *C. pectinata* and *C. truncata* may be satisfactorily distinguished is much wanted.

*Dias longiremis*, Lilljeborg.

*Calanus euchæta*, Lubbock, *Ann. and Mag. Nat. Hist.*, ser. 2, vol. xx, p. 401, pl. x, figs. 1–6 (1857)

This strongly marked characteristic species was found plentifully in Prof. Herdman's Port Erin gatherings.

*Temora longicornis*, Müller.

*Cyclops longicornis*, Müller, *Entom.*, p. 115, t. xix, figs. 7–9 (1785).

*Temora finmarchica*, Baird, *Brit. Entom.*, p. 228, t. xxviii, figs. 1*a*–*g* (1850).

Multitudes of this species were taken in the tow-net near Puffin Island during the cruise of the "Hyæna." It also occurs plentifully among Prof. Herdman's Port Erin gatherings.

*Centropages typicus*, Kröyer.

*Icthyophorba denticornis*, Claus, *Die frei-lebenden Copepoden*, p. 199, pl. xxxv, figs. 1, 8–9 (1863).

*Icthyophorba denticornis*, Brady, *Nat. Hist. Trans. N.* and *D.*, vol. i, p. 40, pl. iv, figs. 1–6 (1864).

One specimen only of this species was found in the tow-net material collected in Hilbre Swash during the "Merry Andrew" expedition.

*Centropages hamatus*, Lilljeborg.

This common species was found abundantly during the cruise of the "Hyæna," off Puffin Island, as well as in Hilbre Swash, and in the Port Erin gatherings.

Brady refers to the "spines of the swimming feet differing remarkably from those of *Centropages typicus*, in having their serrated armature much stronger, and the teeth separated one from another by a wider interval"; but the specimens of the two species which I have examined seem very similar in this respect.

*Anomalocera patersonii*, Templeton (Pl. IV, fig. 2).

*Irenæus patersonii*, Goodsir, *Edin. New Phil. Journ*, xxxv, p. 339, t. vi, figs. 12–17; t. iv, figs. 1–9 (1843).

*Irenæus patersonii*, Claus, *Die frei-lebenden Copepoden*, p. 206, taf. ii, fig. 1, t. xxxvii, fig. 1–6 (1863).

A few specimens of this most interesting species were taken during the cruise of the "Hyæna." It is remarkable for its various colours, many of which are still preserved after mounting in Farrant's solution.

Brady says he has "never been able to find the spine which is said by Dr. Claus to exist in the first segment

of the male abdomen;" it is, however, very well defined in one of the specimens taken off Puffin Island (see Pl. IV, fig 2).

### Family III.—Cyclopidæ.

*Oithona spinifrons*, Boeck.

One female specimen of this species was found amongst Prof. Herdman's Port Erin material. It is a very minute species, and therefore difficult to dissect. Dr. Brady, who has examined the specimen, regards it as an *Oithona*, but considers it doubtful whether or not it really belongs to this, the only hitherto known British species. The specimen seems to me, however, to agree with the essential characters of *O. spinifrons* in all respects.

### Family IV.—Notodelphyidæ.

*Ascidicola rosea*, Thorell.

*Notodelphys ascidicola*, Allman, *Ann. and Mag. Nat. Hist.*, vol. xx, pl. i, figs. 1–13 (1847).

One specimen of this parasitic species was found in the branchial sac of a Simple Ascidian dredged off the South end of the Isle of Man.

### Family VI.—Harpacticidæ.

*Canthocamptus stromii* (?), Baird.

Byerley records this species as having been found by Mr. Weightman at New Brighton, in tide pools, 1853.

*Canthocamptus furcatus.*

Recorded by Mr. Byerley as found at Hilbre, and in pools amongst seaweed around the coast.

*Harpacticus chelifer*, Müller (Pl. IV, fig. 3).

*Cyclops chelifer.* O. F. Müller, *Zool. Dan. Prodr.*, 2413; *Entomostraca*, p. 114, taf. xix, figs. 1-3, 1776.

Recorded by Mr. Byerley as being "not uncommon upon

the shores of Wirral." Found in rock pools on Hilbre Island.

All the specimens of this species which I have examined were females bearing ovisacs; and the dorsal edge of the Cephalothorax was strongly spinose (see Pl. IV, fig. 8).

*Peltidium depressum*, Baird.

*Alteutha depressa*, Baird, *Trans. Berwick Nat, Club*, ii, p. 155, 1845; *Nat. Hist. Brit. Entom.*, p. 216, tab. xxx, figs. 1–2 (1850).

Recorded by Byerley as "found occasionally in pools upon the shore."

Family IX.—Artotrogidæ.

*Caligus rapax*, Milne Edwards.

Recorded by Mr. Byerley as parasitic upon the Sapphirine Gurnard.

*Caligus mülleri*, Leach.

Recorded by Mr. Byerley as having been found attached in great numbers to a *Cyclopterus lumpus*, and on a very large Thornback.

Family.—Doubtful.

——— ———, new species (?).

A single specimen of a very curious female Copepod, with a remarkable constriction in the middle of the cephalothorax, was obtained in the townet, in the neighbourhood of Puffin Island, during the cruise of the "Hyæna." It is unlike any species which has previously been described, and Dr. Brady, to whom the specimen was submitted, states that he considers it a very remarkable form, but that he can say nothing positive in regard to it without dissection and careful examination.

Probably this form is new to science, but it is impossible

to decide the matter definitely, or to give a full description from the single specimen which is now mounted.

It will be interesting to see whether, during next summer's investigations by the Committee, any further specimens of this form are found in the same locality off Puffin Island.

## Explanation of Plate IV.

[Fig. 1.—*Protella phasma*, Dana; young. See page 218.]

Fig. 2.—The spines on the right side of the last thoracic segment, and the first abdominal segment of the male *Anomalocera patersonii*.

Fig. 3.—*Harpacticus chelifer*, female, showing spinose back.

## NOTES on the CIRRIPEDIA of the L. M. B. C. DISTRICT.

BY F. P. MARRAT, FREE PUBLIC MUSEUM.

WHAT is known of the Cirripedes of this district is almost all contained in Byerley's *Fauna.* No satisfactory collection of the species enumerated is to be found either in our Public Museum or in any private collection. Under these circumstances, it is evident that if we wish to procure satisfactory evidence regarding our local species, the specimens must be re-examined and a collection formed. The specimens obtained by the dredging investigations of the Liverpool Marine Biology Committee have added *Chthamalus stellatus* and *Verruca strömia* to the list of species previously recorded.* I take this opportunity of correcting the nomenclature of Mr. Byerley's list.

### THORACICA.

#### Family.—BALANIDÆ.

*Balanus porcatus*, Costa.

*Balanus scoticus*, Wood. = *Balanus eburneus*, Brown.

This is the *Balanus scoticus* of Byerley's list. I remember specimens of this species having been shown to me attached to *Modiola modiolus* which had been brought in by the Liverpool fishing boats.

*Balanus hameri*, Ascan.

Isle of Man and Anglesea, twelve fathoms (Darwin).

* Foreign species brought into the Mersey attached to ships have been omitted.

*Balanus balanoides*, Linn.

This is the very abundant small species of this neighbourhood.

*Balanus perforatus*, Brug.

*Balanus communis*, Pult.

Occasionally found upon *Buccinum* and other shells. Two specimens were dredged from fourteen fathoms, off Puffin Island, during the cruise of the "Hyæna."

*Balanus crenatus*, Brug.

*Balanus rugosus*, Pult.

Recorded by Byerley under the name of *B. rugosus* as "very abundant, attached to seaweed, shells, sea-walls, &c. Thickly set upon the Rock Lighthouse."

The *Balanus clavatus* of Byerley's list is probably only an elongated variety of *B. crenatus*. It is recorded as having being found "in the clefts of the wooden piles about piers," &c.

*Chthamalus stellatus*, Poli.

Very common in shore pools at Fleshwick Bay, Isle of Man.

Family.—Verrucidæ

*Verruca strömia*, O. F. Müller.

On *Laminaria*, Port Erin, Isle of Man.

Family.—Lepadidæ.

*Lepas anatifera*, Linn.

A few years ago a balk of timber was seen floating near the entrance to the Mersey, and was drifted into one of the northern docks. It had evidently been a long time in the water, and was literally covered with specimens of *Lepas anatifera*, ranging in size from about six inches or less to a foot or more in length. From the *Balani* attached to the

wood all being British species, I infer that the pedunculated Cirripedes had also become fastened, and had continued to grow, in some situation not far from the Liverpool district.

## RHIZOCEPHALA.

### Family.—PELTOGASTRIDÆ.

*Sacculina carcini*, Thompson.

Common, attached to the abdomen of Crabs, in Hilbre Swash, &c.

# LIST of the AMPHIPODA of the L. M. B. C. DISTRICT.

By G. Herbert Fowler, B.A., Oxon.,
Berkeley Fellow of the Owens College, Manchester.

The classification on which this list is based is that of Messrs. Spence-Bate and Westwood, in their *British Sessile-eyed Crustacea.*

The letter W signifies that species so marked were obtained and named by Mr. A. O. Walker, of Chester; while [N] and [S] mark species determined by the Rev. A. M. Norman and the Rev. T. R. R. Stebbing, respectively. I take this opportunity of thanking these gentlemen for their kind assistance. Finally, the letter F denotes those species which were collected during the dredging expeditions of the Liverpool Marine Biology Committee.

## Family I.—Orchestiidæ.

*Talitrus locusta*, Latreille.

Colwyn Bay; abundant in drift seaweed at high water mark. W.

## Family II.—Gammaridæ.

### Sub-family—Stegocephalides.

*Stenothoë (Montagua) marina*, Sp. Bate.

Bar of Dee; W. Hilbre Island, one specimen; F., [S.]

*Montagua alderi*, Sp. Bate.

One specimen, Welshman's Gut, "Spindrift" expedition, June 20th. F.

### Sub-family—Lysianassides.

*Lysianassa costæ*, M.-Edwards.

Off Puffin Island, fifteen fathoms, on cruise of "Hyæna,"

May 24th, 1885; F., W., [S.] The characters of the antennæ in this species are not reliable for specific distinction, the flagellum varying in length, and the accessory appendage in the number of joints.

"One of the specimens from Puffin Island has the flagellum of the lower antenna about four times as long as the peduncle, while in the other they are about the same length as the peduncle. In both, the secondary appendage is four to five-jointed, instead of two-jointed, as stated by Spence-Bate (*Brit. Sess. Crust.*, vol. i), and by Boeck." W.

*Lysianassa longicornis*, Lucas.

Off Puffin Island, fifteen fathoms; F., W., [S.] "Probably only a male of the last species"; W.

*Orchomene minutus*, Kröyer.

Colwyn Bay; one specimen, found in a tidal pool. W., [S.]

Sub-family—PHOXIDES.

*Iphimedia obesa*, Rathke.

Port Erin, Isle of Man, August, one specimen. F.

*Sulcator arenarius*, Sp. Bate.

Llanfairfechan. W., [S.]

*Urothoë marinus*, Sp. Bate.

Llanfairfechan. W., [S.]

Sub-family.—GAMMARIDES.

*Amathilla sabini*, Leach.

Common at times, in tidal pools, at Rhos Bay. W.

*Aora gracilis*, Sp. Bate.

Point of Ayr, Rhyl, Puffin Island, fifteen fathoms; Carnarvon Bay, five to ten fathoms. W., F.

*Atylus swammerdamii*, M.-Edw.

Very common in and below the Laminarian zone; common off Bagillt, July 25, 1876, W.; Hilbre Swash, eighteen specimens, May 9th; Penmaenmawr, one specimen,

July; Welshman's Gut, June 20th, seven specimens; Port Erin, Isle of Man, August, one specimen. F.

*Atylus gibbosus*, Sp. Bate.

Port Erin, Isle of Man, August, one specimen. F.

*Atylus* (*Halirages*) *bispinosus*, Sp. Bate.

Rhos Bay. W.

*Bathyporeia pilosa*, Lindström.

Llanfairfechan. W., [S.]

*Bathyporeia pelagica*, var. *robertsoni*, Sp. Bate.

Llanfairfechan; W., [S.] This form, along with *Bathyporeia pilosa*, *Sulcator arenarius*, and *Urothoë marinus*, was dug out of the sand at Llanfairfechan by the Rev. T. R. R. Stebbing and Mr. Walker.

*Calliope læviuscula*, Kröyer.

Very common in tidal pools, Colwyn Bay; W. One specimen was dredged in Hilbre Swash, ten fathoms, F., [S.]

*Calliope bidentata*, Norman.

Point of Ayr. F.; W., [N.]

*Dexamine spinosa*, Leach.

Rhos Bay, Carnarvon Bay; W. Port Erin, Isle of Man, August, eight specimens (two very small specimens lack the characteristic tooth on the first antennae, = *Dex. tenuicornis* ?); F.

*Gammarus locusta*, Linn.

Recorded by Byerley as abundant in tide pools everywhere around the coast.

Very common under stones, Colwyn Bay; W.

Hilbre Swash; Port Erin, Isle of Man; Welshman's Gut; Penmaenmawr; F.

"A black form is common. The red spots on the abdominal segments are not always present." W.

*Gammarus marinus*, Leach.

Port Erin, Isle of Man, four specimens. F.

Some specimens dredged from Welshman's Gut are apparently a variety between *G. locusta* and *G. marinus*, having the first two abdominal segments rounded off, but still not agreeing with *G. campylops* in the form of the last pair of feet. F.

*Gammaropsis (Eurystheus) erythrophthalmus*, Lilljeborg.

Puffin Island, fifteen fathoms, "Hyæna." F., W.

*Megamoera othonis*, M.-Edw.

One specimen, cruise of "Hyæna." F.

*Melita palmata*, Montagu.

Rhos and Colwyn Bays. W.

*Melita obtusata*, Montagu.

Point of Ayr; F., W. Off Puffin Island, "Hyæna;" F., W.

*Moera batei*, Norman.

*Megamoera multidentata*, Bate and West., *Brit. Sess. Crust.*, vol. ii, p. 515.

Puffin Island, fifteen fathoms. F., W., [N.]

"The specimen, taken April 27th, 1881, was named by the Rev. A. M. Norman. It is a female, and it differs widely from the figure given by Bate and Westwood, as regards the second cheliped (gnathopod of B. and W.). In our specimen, the wrist is three times as long, and nearly as wide, as the hand." W.

*Pherusa bicuspis*, Kröyer.

= *Pleustes bicuspis*.

Bar of Dee, Rhyl, Puffin Island, cruise of "Hyæna," fifteen fathoms. F., W.

*Pherusa fucicola*, Leach.

(See Sp. Bate, *Cat. Amphib. Crust. Brit. Mus.*, pl. xxvii, fig. 10—not fig. 9.) Rhos Bay; W., [N.] One specimen was

obtained in a tidal pool between Llandrillo yn Rhos and the Little Ormes Head.

*Photis reinhardi*, Kröyer.

*Eiscladus longicaudatus*, Sp. Bate.

One specimen from oyster-bed in Colwyn Bay, three to five fathoms. W.

### Family III.—Corophiidæ.

#### Sub-Family.—Podocerides.

*Amphithoë podoceroides*, Rathke.

*A. littorea*, Sp. Bate = *A. rubricata*, Montagu.

Tidal pools, Rhos Bay; W. Port Erin, Isle of Man. Seven young specimens, one adult; F., [S.]

*Podocerus falcatus*, Montagu.

Generally distributed; W. Two specimens Port Erin, Isle of Man. F.

*Podocerus pelagicus*, Leach.

Five specimens, Port Erin, Isle of Man. F.

*Podocerus pulchellus*, Leach.

Six specimens, Port Erin, Isle of Man. F.

The last two species may be varieties of *P. falcatus*.

*Podoceropsis sophia*, Boeck.

*Naenia tuberculosa*, Sp. Bate.

Bar of Dee, Colwyn Bay. W.

*Sunamphithöe hamula*, Sp. Bate.

Six specimens, Port Erin, Isle of Man. F.

*Cerapus abditus*, Templeton.

Point of Ayr. F., W. "When alive, this species is prettily freckled, and the antennæ barred with red; eyes bright scarlet" (A. O. W.)

Sub-family.—COROPHIIDES.

*Corophium grossipes*, Linn.

*C. longicorne*, Fabr.

On mud flats, its burrows covering acres in the Dee. W. In tide pools. Byerley.

*Naenia rimipalmata*, Sp. Bate.

*N. excavata* = *Xenoclea batei*, Boeck.

Penmaenmawr, one specimen; "Hyæna," one specimen. F., [S.]

Family IV.—CHELURIDÆ.

*Chelura terebrans*, Philippi.

In great numbers, in wood from the breakwater, Port Erin, Isle of Man. F.

Family V.—DULICHIIDÆ.

*Dulichia porrecta*, Bate.

Recorded by Bate and Westwood "from deep water between the Dee and the Mersey." (Dr. Walker.)

Family VI.—HYPERIIDÆ.

*Hyperia medusarum*, Müller.

*H. galba*, Montagu.

Colwyn Bay, etc.; common in *Rhizostoma*. W.

Family VII.—CAPRELLIDÆ.

*Proto pedata*, Mont.

Two specimens, Port Erin, Isle of Man. F.

*Protella phasma*, Dana.

"Very plentiful amongst seaweed, Zoophytes, and Sponges at Hilbre and elsewhere" (Byerley). Probably Mr. Byerley's specimens were *Caprella linearis*, which appears to be the commonest species of the family at Hilbre Island.

Seven adult and six young specimens of *P. phasma* were obtained off Port Erin, Isle of Man. F.

NOTE.—The six specimens from Port Erin, recorded as the young of *Protella phasma*, are thus regarded in consequence of a note of Mayer (*Fauna u. Flora d. Golf. v. Neapel*, VI, p. 30), though at first believed to be a new species. To prevent future error an outline drawing is appended, Pl. IV, fig. 1; none of the characteristic spines on the back are developed except that on the head; and the palm of the second cheliped is much simpler than that of the adult, exhibiting only one, not very strong, tooth. F.

*Caprella linearis*, Linn.

Forty-four specimens, mainly from Hilbre; one from Port Erin. Under this species is now ranked *C. lobata* as the male, as was suggested by Bate and Westwood, and definitely laid down by Mayer in his recent monograph on the Naples Caprellidæ. F.

*Podalirius typicus*, Kröyer.

On the interambulacral spaces of *Asterias rubens*. Off Prestatyn, abundant, July 10th, 1885. W.

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The above list of species is entirely new to the district, except for the three recorded by Mr. Byerley, namely:—*Corophium longicorne*, *Gammarus locusta*, and *Caprella phasma*.

## LIST OF THE ISOPODA.*

### Family I.—CYMOTHOIDÆ.

*Eurydice pulchra*, Leach.

* I have drawn up this list from Byerley's *Fauna* and from notes supplied to me by Mr. A. O. Walker and Mr. I. C. Thompson.—ED.

"This species swarms in the Dee, where it bites bathers." W.

Family II.—SPHÆROMIDÆ.

*Sphæroma serratum*, Fabr.

Colwyn Bay; Mersey, above Ellesmere Port, under stones. W.

Family III.—IDOTEIDÆ.

*Idotea tricuspidata*, Desmarest.

Colwyn Bay, Dee, etc. W.

*Idotea linearis*, Pennant.

Along the coast.

These two species of *Idotea* are often found on floating drift weed. W.

*Arcturus longicornis*, Sow.

Dredged at the mouth of the Dee. Byerley.

Family V.—ASELLIDÆ.

*Jaera albifrons*, Mont.

Colwyn Bay and Rhos Bay, in tidal pools. W.

*Janira maculosa*, Leach.

Bar of the Dee. W.

*Limnoria lignorum*, Rathke.

Dee and New Brighton. Bate and Westwood.

Byerley records this species from the Mersey, under the name of *L. terebrans*, and states that the wooden piles of the Rock Lighthouse are completely drilled by it.

"I have never seen or heard of any signs of this wood-boring pest in the Dee, though I have asked men who have removed old piles." W.

### Family VIII.—Oniscidæ.

*Ligia oceanica*, Linn.

Sparingly at Hilbre and Egremont. Byerley.

Colwyn Bay. W.

I am informed by Mr. Moore, that he and Mr. Marrat have seen at nightfall vast numbers of this species issue from between the layers of rock at Hilbre.

# REPORT on the PODOPHTHALMATA of the L. M. B. C. DISTRICT.

By Alfred O. Walker, F.L.S., Chester.

## Order.—PODOPHTHALMATA.

### Sub-order.—SCHIZOPODA.

#### Family.—Mysidæ.

*Mysis flexuosa*, Müller.

*Mysis Chamæleon*, Bell.

Dee, opposite Flint. Common in tidal pools at Rhos Bay (Colwyn Bay).

*Mysis spiritus*, Norman.

Rhos Bay.

Dredged off Puffin Island, depth fifteen fathoms, during the cruise of the "Hyæna," on May 24th, 1885.

### Sub-order.—DECAPODA.

#### Section I.—MACROURA.

#### Family.—Carididæ.

*Pasiphœa sivado*, Risso.

Two specimens were taken in 1884, below Point of Ayr. Mr. Moore informs me that two specimens of this species were brought to him from the Mersey in 1864, and that one specimen was taken on the Cheshire coast late in 1885.

*Palœmon serratus*, Penn.

Common Prawn; sometimes taken in considerable numbers with the Shanks, but not very abundant anywhere.

*Pandalus brevirostris*, Rathke.

*Hippolyte thompsoni*, Bell.

Dredged off Puffin Island, depth fifteen fathoms, during the cruise of the "Hyæna," May 24th, 1885.

*Pandalus annulicornis*, Leach.

The Shank or Œsop Prawn. Very abundant on stony ground. Immense quantities are taken by the shrimp trawlers off Prestatyn.

*Hippolyte pusiola*, Kröyer.

One specimen was obtained off Puffin Island during the cruise of the "Hyæna," on May 24th, 1885.

The colouring of this species, when fresh, is very beautiful. The upper portion of the carapace is generally milky white, the under part and legs spotted with red ; the abdominal segments more or less yellow, with a ring of white just above the tail.

*Hippolyte cranchii*, Leach.

One specimen was obtained off Puffin Island, during the cruise of the "Hyæna," on May 24th, 1885.

*Hippolyte varians*, Leach.

Common in tidal pools.

*Crangon (Cherophilus) trispinosus*, Hailstone.

Obtained off Puffin Island, from a depth of fifteen fathoms, during the cruise of the "Hyæna," May 24th, 1885.

*Crangon (Ægeon) sculptus*, Bell.

Three specimens were dredged off the south end of the Isle of Man.

*Crangon (Ægeon) fasciatus*, Risso.

Two specimens were dredged off Puffin Island, in fifteen fathoms, during the cruise of the "Hyæna," on May 24th, 1885.

*Crangon vulgaris*, Fabr.

Very abundant on sandy shores.

Family.—ASTACIDÆ.

*Nephrops norvegicus*, Linn.

Said to have been taken at Holyhead (*Bell's Brit. Crust.*, p. 254).

*Homarus vulgaris*, Edw.

Common Lobster. As far as I know this is not fished for nearer Liverpool than Amlwch, but it has been taken in Rhos Bay east of the Little Orme; it has been found on Hilbre Island by F. P. Marrat.

Family.—GALATHEIDÆ.

*Galathea strigosa*, Fabr.

One small specimen of this species, not half-an-inch long, but with eggs, was dredged off Puffin Island, fifteen fathoms, during the cruise of the "Hyæna," on May 24th, 1885.

*Galathea intermedia*, Lilljeborg.

*Galathea andrewsi*, Kinahan.

Obtained in the Menai Straits during the cruise of the "Hyæna," on May 24th, 1885; also in Hilbre Swash, depth ten fathoms; and off Port Erin, Isle of Man.

*Galathea squamifera*, Mont.

One specimen was dredged off the south end of the Isle of Man.

Section II.—ANOMOURA.

Family.—PAGURIDÆ.

*Pagurus bernhardus*, Linn.

Very abundant from Hilbre Swash and Point of Ayr all along the coast.

*Pagurus prideauxii*, Leach.

Off Port St. Mary, Isle of Man, along with *Adamsia palliata*.

*Pagurus cuanensis*, Thompson.

One specimen was dredged off the south end of the Isle of Man in August.

Family.—PORCELLANIDÆ.

*Porcellana platycheles*, Penn.

Hilbre Swash. Formerly common under stones at Penmaenmawr and Colwyn Bay, but I have seen none there lately.

Found at Hilbre Island last summer by some members of the Committee.

*Porcellana longicornis*, Penn.

Common under stones at Colwyn Bay, Penmaenmawr, etc.

A specimen found by Mr. Thompson at Penmaenmawr has the chelipedes equal.

Section III.—BRACHYURA.

Family.—CORYSTIDÆ.

*Thia polita*, Leach.

One specimen was obtained on the western end of the Constable Bank, near Llandudno, from a depth of six to seven fathoms, during the cruise of the "Hyæna," May 23rd, 1885.

*Corystes cassivelaunus*, Penn.

Along the coast from Hilbre Swash to Menai Straits.

Family.—LEUCOSIADÆ.

*Ebalia tuberosa*, Penn.

*Ebalia pennantii*, Leach.

Off the south end of the Isle of Man, one male specimen.

*Ebalia tumefacta*, Montagu.

*Ebalia bryerii*, Leach.

Off the south end of the Isle of Man, two female specimens.

*Ebalia cranchii*, Leach.

Off the south end of the Isle of Man, one male specimen.

It seems doubtful whether the last two species are distinct.

### Family.—Gonoplacidæ.

*Gonoplax angulata*, Fabr.

One specimen has occurred at Southport (C. H. Brown).

### Family.—Pinnotheridæ.

*Pinnotheres pisum*, Penn.

In Mussel shells.

### Family.—Portunidæ.

*Carcinus mœnas*, Linn.

Very abundant. Is there any reason why *Portunus carcinoides* (Kinahan, in *Nat. Hist. Review*, 1857), should not be referred to this species?

*Portunus puber*, Linn.

Point of Ayr, one specimen, 1878.

*Portunus arcuatus*, Leach.

Mouth of the Dee; Colwyn Bay. Not common.

*Portunus depurator*, Linn.

Very abundant, three to seven fathoms.

*Portunus pusillus*, Leach.

Off Port Erin, Isle of Man, one specimen.

*Portumnus latipes*, Penn.

Beach, Penmaenmawr (R. D. D.)

### Family.—Eriphidæ.

*Pilumnus hirtellus*, Linn.

Great and Little Ormes Heads; Puffin Island, seven to fifteen fathoms; Bar of Dee.

### Family.—CANCRIDÆ.

*Cancer pagurus*, Linn.

Rhos Bay; common, but small.

### Family.—PARTHENOPIDÆ.

*Eurynome aspera*, Penn.

One specimen was obtained off Puffin Island, from a depth of fifteen fathoms, during the cruise of the "Hyæna," May 24th, 1885; off the south end of the Isle of Man, August, 1885.

### Family.—MAIIDÆ.

*Stenorynchus rostratus*, Linn.

*Stenorynchus phalangium*, Penn.

Very common in stony places, five to ten fathoms.

*Achæus cranchii*, Leach.

Off Port Erin, Isle of Man, twenty fathoms (L. Adams).

*Inachus dorsettensis*, Leach.

Off Port Erin, Isle of Man; one specimen.

*Hyas araneus*, Linn.

Off Little Ormes Head, seven to ten fathoms.

*Hyas coarctatus*, Leach.

Stony places, five to ten fathoms.

# REPORT on the PYCNOGONIDA of the L. M. B. C. DISTRICT.

By W. B. Halhed.

This group does not appear to have hitherto engaged much attention in this locality, the only previous record of examples found in the Liverpool Bay being in Mr. Byerley's *Fauna*, published in 1855, where only two species are mentioned, namely, *Pycnogonum litorale* and *Nymphon gracile*, which latter title, as a convenient name for all long-legged Pycnogonida, seems generally to have satisfied observers who have lacked the time or the interest to make careful examinations, and to mark the distinct differences which characterise the various genera of this interesting group of animals.

The L. M. B. C. dredging investigations of this first season enable us to add to the brief list at least five additional species, to wit:—

*Phoxichilidium femoratum*, Rathke.
*Phoxichilus spinosus*, Montagu.
*Achelia echinata*, Hodge.
*Achelia hispida*, Hodge.
*Pallene brevirostris*, Johnston.

and doubtless future work in the locality will still further extend the number.

As no complete detailed description has ever been given of the British Pycnogonids, it is necessarily a laborious and somewhat difficult matter to trace the history of the various species, and identify the specimens correctly. Fortunately, Dr. Hoek's "Challenger" Report, recently published, gives a list of all known species of the group, with references to

previous records; but these records are widely scattered, and not all available. The more important of the references are given below, under the head of the species to which they refer.

Some specimens, found both off the Isle of Man and off Puffin Island, have the characteristics of Mr. H. Goodsir's *Pephredo hirsuta*, a species which has never been sufficiently described. On account, however, of the uncertainty as to the exact characters of Goodsir's species, it is deemed better to place the specimens provisionally under the title of "*Nymphon gracile*," a species to which they are at least closely allied.

Some of the specimens of Pycnogonids collected had masses of ova, or embryos, attached, all apparently in a very early stage of development.

It is to be hoped that the investigations of the Liverpool Marine Biology Committee, during the coming summer, may lead to the acquisition of a larger number of specimens belonging to this interesting but obscure group. The British Pycnogonida seem to be still very imperfectly known. They require to be thoroughly examined, the species in some cases re-described and figured, and the synonymy cleared up. This, however, cannot be satisfactorily done until a considerable collection has been obtained.

In the arrangement and nomenclature of species, I have followed Hoek's Report upon the "Challenger" Pycnogonida (*Zool. Chall. Exp.*, Part x, 1881). The four families recognised by Hoek (Nymphonidæ, Colossendeidæ, Pallenidæ, and Phoxichilidæ). are all represented in the Liverpool Bay collection.

### Family I.—Nymphonidæ.

*Nymphon gracile* (?), Leach.

*Nymphon gracile*, Leach, *Zool. Misc.*, vol. i, p. 45, 1814; Hoek, "Challenger" Report, p. 20.

This species is recorded by Mr. Byerley as being in most

rocky pools at Hilbre, New Brighton, &c. That may have been so in 1855, but it is certainly not the case now. However, it is really very doubtful what species was meant by *Nymphon gracile*, as that name has been applied by naturalists to a number of the commoner species of Nymphonidæ and the allied families indiscriminately.

Under this species may be placed provisionally some specimens obtained both off the south end of the Isle of Man (fifteen fathoms) and also off Puffin Island (eleven to thirteen fathoms), which show some of the characteristics of *Pephredo hirsuta*, a species described briefly by H. Goodsir in 1842. Goodsir's specimen was from the Isle of Man, but it has not been found since, and its position and relations are still very uncertain. The Liverpool Bay specimens appear to have more than three joints in the palpus, and therefore ought not to belong to the genus *Pephredo*. The examination of more material from this neighbourhood is much to be desired, as it may result in the clearing away of the existing doubts as to Mr. Goodsir's species.

### Family II.—Colossendeidæ.

*Achelia echinata*, Hodge.

> *Achelia echinata*, Hodge, *Ann. and Mag. of Nat. Hist.*, 3rd series, vol. xiii, p. 115, 1864; and Hoek, "Challenger" Report, p. 26.

One example of this Pycnogonid was obtained during the cruise of the "Hyæna," on 24th May, 1885. It has all the characteristics of Hodge's description. The species has previously been found at the Isle of Man, as well as at a few other points on the English coast.

*Achelia hispida*, Hodge.

> *Achelia hispida*, Hodge, *Ann. and Mag. of Nat. Hist.*, 3rd series, vol. xiii, p. 115, 1864; and Hoek, "Challenger" Report, p. 27.

Two specimens, found during the cruise of the "Hyæna," appear to be referable to this species, which has only been previously found on the Cornwall coast. Hoek doubts whether this is a good species.

### Family III.—PALLENIDÆ.

*Pallene brevirostris*, Johnston.

*Pallene brevirostris*, Johnston, *Mag. of Zool. and Bot.*, vol. i, 1837; and Hoek, "Challenger" Report, p. 30.

A single specimen of this species was found off Spanish Head, Isle of Man, depth 20 fathoms.

*Phoxichilidium femoratum* (?), Rathke.

*Nymphon femoratum*, Rathke, *Naturh. Selsk. Skr.*, vol. i. p. 201, 1799.

*Orithyia coccinea*, Johnston, *Mag. of Zool and Bot.*, vol. i, p. 378, 1837.

*Phoxichilidium femoratum* (Rathke), Hoek, "Challenger" Report, p. 32.

One of the specimens dredged off Puffin Island during the cruise of the "Hyæna" belongs undoubtedly to the genus *Phoxichilidium*, and is probably the *Orithyia coccinea* of Johnston, which Hoek regards as the same species as Rathke's *Nymphon femoratum*. A further examination will, however, be necessary before the matter can be settled conclusively.

An immature specimen, obtained off Port Erin, Isle of Man, from a depth of twelve fathoms, probably belongs to this genus, but cannot be referred to its proper species.

### Family IV.—PHOXICHILIDÆ.

*Phoxichilus spinosus*, Montagu.

*Phalangium spinosum*, Montagu, *Linn. Transact.*, vol. ix, p. 100, 1808.

*Phoxichilus spinosus* (Montagu), Hoek, "Challenger" Report, p. 35

Three specimens of this species were obtained during the dredging expeditions, one male and one female, brought up near Puffin Island from a depth of fourteen fathoms, during the cruise of the "Hyæna," on May 24th, 1885; and one female, dredged off Port Erin, Isle of Man, from fifteen fathoms, in August, 1885.

The Puffin Island specimens had been preserved in glycerine, and shewed well the characteristic colour of the species (purple red), but this colour was lost in the other specimen, which had been preserved in alcohol.

On the male specimen, obtained in May, ova in large quantity were attached to the legs.

*Pycnogonum litorale*, Ström.

*Phalangium litorale*, Ström, *Phys. og Œcon. Beskr.*, &c., Soröe, 1762.

*Pycnogonum litorale* (Ström), Kröyer, *Bidrag til Kundskab*, *Nat. Tid. Ny. Raekke*, vol. i, p. 126, 1845; Hoek, "Challenger" Report, p. 85.

This well known and widely distributed species is fairly common in Liverpool Bay. It is recorded by Byerley as being "abundant amongst seaweed and Zoophytes where there are patches of rock."

It has been taken by members of the Liverpool Marine Biology Committee, during 1885, on the rocks at Hilbre Island, and in the neighbourhood of Penmaenmawr.

# REPORT on the TESTACEOUS MOLLUSCA* of the L. M. B. C. DISTRICT.

By R. D. Darbishire.

During the past, their first season, the Committee's operations have necessarily been tentative only. At best, a dredge 30 inches wide, dragged for twenty minutes, at intervals of from half a mile to two miles or more apart, over unselected and unknown bottom, subject to unknown conditions of tidal or fluviatile influence, can exhibit only the merest glimpses of a fauna, and few indeed of accurate biological history. And the repetition of such a day's work at various times during the quiet days of summer, over different grounds, scarcely adds quality to the "research." Moreover, the Committee's district is characteristically wanting in rocky shores or bottom, and consequently in the vegetable growths on which many Mollusca feed.

The Committee has endeavoured to systematize specific observation at Hilbre Island (which is of red sandstone rock), and has already recognised the special gains of repeated visitation and record.

It is to be hoped that a similarly thorough examination of other particular localities will become part of their work, or will be undertaken by individual naturalists. The nature of the sea bottom has to be ascertained, mapped, apportioned, and studied, and the varying conditions of submarine equilibrium duly noted—partly by the help of actual survey

* The Nudibranchiata are discussed in a separate Report (see p. 267); and the specimens of Cephalopoda collected by the L. M. B. C. have been examined by Mr. Hoyle, of the "Challenger" Office, Edinburgh, who has furnished me with the notes forming the supplemental Report on the Cephalopoda found at p. 278.—[Ed.]

in regular lines, and partly by means of the experience of fishermen.

When information of this kind is accessible, the Committee or volunteers can select localities where the conditions of habitat can be carefully observed, and the assemblage of animals and their life histories definitely studied on the scale at which the Committee aims. If the naturalists' investigation is to assume any real completeness, such researches must in many cases moreover be repeated, not only month after month, but at dawn, at noon, at sunset, and at midnight.

For really effective work of the kind they contemplate, the Committee cannot long dispense with the employment of a special steamer and trained assistance. It is to be hoped that the narrative of what they have already done may help to bring about such an extension of their apparatus. As necessary a development must eventually be the establishment of a laboratory.

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With regard to the Testaceous Mollusca, the actual experience of the Committee has been so slight that they can only offer a few memoranda rather than a detailed report.

The observations hitherto made have been only experimental, and, it is only too true that, except at and near the shore at Hilbre Island, if there are any spots between Formby Point and Puffin Island where Molluscs flourish, the Committee have not yet been fortunate enough to find them. A certain assemblage of dead shells, with a few living ones, was observed whenever the dredge was used, but the number of species, and indeed that of specimens, has been disappointing so far.

In what follows there has been no attempt to record the name of every species of which a dead shell was found (except

in § 3), but only to set down the more notable occurrences and a few observations.*

The matter in the reporter's hands is offered as follows:

(1.) A list of notable species taken, alive or dead, during any of the Committee's expeditions, including Mr. Thompson's Penmaenmawr and Professor Herdman's Isle of Man shells.

(2.) Some notes by collectors on particular species at different places on the shores of the Committee's district.

(3.) A table of local lists within the same district.

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### (1.) The Committee's List.

The Committee dredged on the 9th of May in Hilbre Swash; and on the 24th, 25th, and 26th of May (from the "Hyæna") off Llandudno, in the Menai Straits, and round Puffin Island; and again on the 20th of June off Hilbre Island and Point of Ayr.

They have had several special excursions for shore work on Hilbre Island at low water, and two or three members explored at Hoylake, and at Blundellsands and Waterloo; while Mr. Thompson worked continuously at Penmaenmawr and in dredging round Puffin Island. Professor Herdman dredged and searched the shores at the south end of the Isle of Man, for some weeks in July and August.

## LAMELLIBRANCHIATA.

*Anomia ephippium*, L.
Off Port Erin, Isle of Man.

* It is a question how long dead shells may drift about on a sandy shore, buried and washed out again. A shore may be full of shells of many years' deposit. On the other hand, it seems certain that the multitude of country people and children who take shells home do really dispose of such accumulations. At Southport, *Turritella terebra* on the beach, and *Helix nemoralis* on the sandhills, are very much less common than they used to be.

*Anomia patelliformis*, L.

Valves, 14 fathoms, north of Puffin Island.

*Ostrea edulis*, L.

Single old specimens in Menai Straits, and off Penmaenmawr, and off Puffin Island.

*Pecten pusio*, L.

*Pecten varius*, L.

*Pecten tigrinus*, Müll.

Dead valves of these species, off Puffin Island, north, and off the south end of the Isle of Man. Young specimens of *P. varius* were also found at Port Erin, and also valves of *P. tigrinus*, var. *costata*.

*Pecten opercularis*, L.

Small specimens dredged on Constable Bank, Menai Straits, off Penmaenmawr, and off Puffin Island, and at Port Erin, Isle of Man, but not one full-grown one.

*Lima loscombii*, Sow.

Valves off Great Ormes Head, and at south end of Isle of Man.

*Lima elliptica*, Jeff.

Valves off south end of Isle of Man.

*Mytilus edulis*, L.

Occurs in large beds in the estuary of the Conway River, and at various places on the shore, and in deeper water east and west of Great Ormes Head.

*Mytilus barbatus*, L.

Off Puffin Island, alive, amongst a mass of dead shells.

*Modiolaria marmorata*, Forbes.

Port Erin, Isle of Man.

*Nucula nucleus*, L.

Dredged off south end of Isle of Man.

*Pectunculus glycimeris*, L.

Valves and young specimens dredged off Port Erin and Port St. Mary, Isle of Man.

*Cardium echinatum*, L.

Penmaenmawr.

*Cardium norvegicum*, Speng.

Young shells living in Menai Straits, and off south end of Isle of Man.

*Astarte sulcata*, Da C.

Two specimens from Port Erin, Isle of Man.

*Venus fasciata*, Da C.

Living with the last.

*Venus casina*, L.

Living, both large and small, off Port Erin, Isle of Man.

*Venus gallina*, L.

One large old specimen and several smaller, from Port Erin and Port St. Mary, Isle of Man. They are rather pale in colour. Common at low-water at Penmaenmawr and Southport.

*Venus exoleta*, L.

Large valves were dredged off Port Erin, Isle of Man.

*Venus ovata*, Penn.

Dead valves, fourteen fathoms, off Puffin Island, N.

*Tapes pullastra* (*perforans*), Mont.

At Hilbre Island.

*Tapes virgineus*, L.

Port Erin, Isle of Man.

*Tellina donacina*, L.

Fourteen fathoms, off Puffin Island.

*Tellina balthica*, L.

New Brighton, Port Erin, &c. Everywhere on sandy shores.

*Psammobia tellinella*, Lam.

One large and well-coloured shell taken living in Menai Straits.

*Psammobia ferroensis*, Chem.

Valves. Occurs alive and fine, in channels at low-water, near Penmaenmawr.

*Mactra solida*, L.

Not unfrequent off Constable Bank, Menai Straits, and north of Puffin Island, living, old and young, many characteristic and fine specimens; also, off Port Erin, Isle of Man.

*Mactra solida*, var. *elliptica.*

Young, from Port Erin, and off Great Ormes Head.

*Mactra stultorum*, L.

With the last, but not so common or so fine. Valves common on Waterloo Shore.

*Lutraria elliptica*, Lmk.

Valves frequent at Penmaenmawr, and occur at Southport.

*Scrobicularia prismatica*, Mont.

A few valves off Puffin Island, N.

*Scrobicularia alba*, Wood.

Living specimens rare, and dead valves frequent with the last. Extremely abundant on the Red Wharf Bay sands. Sometimes, in summer, a *ridge* of these shells, quite fresh, but without the animal, will lie on high-water mark for very many yards.

*Thracia prætenuis*, Pult.

Port Erin, Isle of Man. Dredged alive.

*Corbula gibba*, Olivi.

During cruise of "Hyæna," six miles off Great Ormes Head, fourteen fathoms.

*Mya binghami*, Turton.

One alive in a crevice at the base of *Alcyonium*, from fourteen fathoms, north of Puffin Island.

*Mya arenaria*, L.

Abundant in mud at Bagillt, and sometimes eaten. Large specimens used to be obtained alive in the Mersey. This species is now spreading and multiplying northwards from Crosby, in muddy places. It is sold for food at Crosby.

*Saxicava rugosa*, L.

Same locality, and also common on *Laminaria*, off Port St. Mary, Isle of Man.

*Pholas crispata*, L.

In red sandstone rock, at Hilbre Island, up to about two inches in length.

## SCAPHOPODA.

*Dentalium entale*, L.

Alive, off south end of Isle of Man. Dead, trawled off Red Wharf Bay, seven to eight fathoms. Not uncommon on beach at Penmaenmawr and Southport.

## POLYPLACOPHORA.

*Chiton cancellatus*, Sow.

Off south end of Isle of Man.

*Chiton albus*, L.

Off south end of Isle of Man.

*Chiton cinereus*, L.

Off south end of Isle of Man. Also in Menai Straits and at Penmaenmawr. Very common.

*Chiton lævis*, Mont.

Off south end of Isle of Man. Also in Menai Straits.

## GASTROPODA.

*Patella vulgata*, L.

Common on shore at Port Erin.

*Helcion pellucidum*, L.

On *Laminaria*, Port St. Mary, and Colwyn Bay.

*Emarginula fissura*, L.

Port Erin.

*Fissurella græca*, L.

Off south end of Isle of Man.

*Trochus magus*, L.

Several large specimens of the (Manx) coarse pallid form, from near Port Erin.

*Trochus cinerarius*, L.

Port Erin and Port St. Mary, on the shore, large. Bar of Dee, Colwyn Bay, Great Ormes Head.

*Trochus tumidus*, Mont.

Off south end of Isle of Man.

*Trochus zizyphinus*, L.

Alive, off south end of Isle of Man.

Alive, with *Mactra solida*, off Great Ormes Head, seven to eight fathoms.

*Phasianella pullus*, L.

Off south end of Isle of Man.

*Velutina lævigata*, Penn.

Off Port Erin, etc., Isle of Man.

*Aporrhais pespelicani*, L.

Off north end of Isle of Man, ten to twenty fathoms.

*Buccinum undatum*, L.

Very common all along the Welsh coast, living at and below low-water.

*Murex erinaceus*, L.

Off Port St. Mary, etc. Fine specimens dredged in Menai Straits, off Puffin Island.

*Natica catena*, Da Costa.

*Natica alderi*, Forbes.

*Fusus antiquus*, L.

From south end of Isle of Man.

Off Great Ormes Head, seven to eight fathoms.

*Fusus gracilis*, Da Costa.

Dead, both localities with last species. Alive, off the Little Ormes Head (A. O. W.)

*Trophon muricatus*, Ström.

Off south end of Isle of Man.

*Trophon barvicensis*, John.

Young, Port Erin, Isle of Man.

*Mangelia turricula*, Mont.

Living, Port Erin, and also off Penmaenmawr.

*Mangelia nebula*,

Port Erin, Isle of Man.

*Philine aperta*, L.

Off Penmaenmawr, living.

*Cypræa europæa*, Mont.

Off Penmaenmawr, and off south end of Isle of Man; adult and young.

*Aplysia punctata*, Cuv.

Off Port Erin, Isle of Man, ten to twenty fathoms, common.

*Pleurobranchus membranaceus*, Mont.

South end of Isle of Man, shore, common in some places.

[For the list of Cephalopoda see end of Special Notes, p. 245.—Ed.]

(2.) Special Notes.

*Anomia patelliformis* and *Pecten pusio* occur frequently as dead valves of very old individuals on the beach at Penmaenmawr, telling of some oyster bed within reach of the shore currents. The oyster bed may have ceased to exist for years.

*Pecten maximus*, L. Dead valves occasionally at Penmaenmawr.

*Mytilus edulis*. Young and small pellucid shells sometimes clothe the large stones at low water at Blackpool, where large shells are seldom found.

Since the railway very greatly increased the export into Lancashire, etc., of mussels from Conway Bay, the average size has greatly decreased. Some years ago, large quantities of mussels were raked up in Conway Bay, and boiled in huts on the east shore to get seed pearls. These were bought by a traveller at 4s. per oz. A woman could earn 12s. per week at this harvest (see *Land and Water*, Oct. 15, 1872). The trade has ceased, but large masses of blue shells (which have been described as raised sea bottom) remain above the shore.

*Mytilus modiolus*, L. Sometimes, in summer, a number of specimens of this animal will be thrown up on Penmaenmawr beach, alive, often enclosing *Pinnotheres pisum*.

*Cardium echinatum* occurs fresh and fine at Penmaenmawr and at Southport, but I have never seen the animal, and do not know where it lives (D.)

*Cardium edule* is largely collected on Conway and Lavan sands, and on the banks off Bagillt and Holywell, and at Southport and Blackpool.

A curious variation of habit arises when young cockles get amongst mussels, and, being anchored by the byssus threads of the latter animal, grow and develop freely without being buried in sand, as well-bred cockles should be. These open-water cockles produce a circular, delicate, and very pretty variety of shell (Conway Bay).

*Cyprina islandica* has, not unfrequently, been found alive in the channels between banks of the Lavan Sands, off Llanfairfechan (probably cast out from some of the seagoing hookers as they are cleaned up while running in to Bangor).

In one such shell was found a fine specimen of *Malacobdella grossa*. A workman at Penmaenmawr, who ate *Cyprina*, was said to have been badly " musselled."

*Venus lincta*, Pult., and *V. exoleta*, L. Valves occur at Penmaenmawr.

*Venus fasciata*. Common at low-water, at Beaumaris.

*Tapes virgineus* occurs on the beach at Penmaenmawr and Colwyn, and dredged off Llandudno and Conway.

*Tapes pullastra* is common on the same beaches, but I have not found its habitat (D.).

*Tapes decussatus*. The like remarks as to this. Large valves occurred in a kitchen midden on the Ormes Head, at Gwyfyd, near Llandudno.

*Lucinopsis undata*, Penn. Occurs fresh, but without the animal, at Penmaenmawr.

*Tellina crassa*, valves found at Colwyn Bay.

*Ceratisolen legumen* and *Solen vagina*, both species somewhat localised occur in abundance and well grown in the low water channels below Penmaenmawr. The former, and a small form of *Solen ensis*, very abundant at Southport.

*Mactra stultorum*. Very common and large at Southport and Blackpool, where they used to be eaten boiled or raw. Sometimes immense quantities of young shells are cast up along high-water mark, quite fresh, but without the animals.

*Solen pellucidus* is dredged fine in Conway Bay, four to six fathoms.

*Thracia convexa*, dead valves occur occasionally on the beach at Southport. I have dredged fresh valves (but not the mollusc) off Whitehaven (D.).

*Thracia papyracea* is often thrown up on the beach at Penmaenmawr in considerable numbers, but I have never found it at home (D.).

*Mya truncata* lives in the channels below Bangor, in stinking black mud, growing large, but discoloured in the shell.

A form, greatly abbreviated, occurs within the influence of the Conway River.

Sometimes large numbers are thrown up by the sea on Colwyn sands, with the chitinous siphon cases quite perfect, but the animal altogether gone.

*Saxicava rugosa*, which is extraordinarily abundant in the limestone on Puffin Island and Anglesey tidal rocks, may sometimes be dredged amongst dead shells in Conway Bay of a large size and free growth.

*Pholas crispata.* This shell occurs rarely at Southport, and more frequently from Point of Ayr to Rhyl and Abergele as very worn dead valves of large size. It lives in the red sandstone rock at Hilbre Island, where it grows to about two inches in length.

A prolonged search at last found this animal living in abundance, and of very great size, in coarse sandy mud near Beaumaris. Specimens measuring 3·4 inches are not uncommon, and 3·7 inches and 3·8 inches have occurred to me. I have found shells of this species, subfossil, at Bracklesham Bay 4·2 inches long (D.).

*Pholas candida.* A curious distribution of valves along the shore from Southport past Formby Point was noticed. North of the Point, one valve was common and the other rare; southward, the latter valve was the common one. Experiment proved that this separation was probably due to the behaviour of a shell, so peculiarly shaped and balanced, in the prevailing tidal flux, as it brought the valves up from low-water. Great colonies in blue clay at low-water at Blackpool. Sometimes eaten boiled.

*Chiton fascicularis* occurs of large size amongst stones west of Redwharf Bay, Anglesey.

*Helcion pellucidum* occurs of large size amongst *Laminaria* on Puffin Island.

*Tectura testudinalis* occurs rarely amongst shingle at low water at Fleetwood.

*Crepidula fornicata*, L., has been found amongst the shells of *Ostrea virginica*, Gmel., of which vast numbers were planted (apparently in vain) on the shore near Beaumaris.

*Natica alderi*, lives and grows large in channels near low water below Penmaenmawr.

*Lamellaria perspicua*, L., under stones at Bagillt.

*Velutina lævigata*, dredged in Menai Straits.

*Aporrhais pespelicani*. Common on the beach, Red Wharf Bay, and found from Formby to Blackpool. At Southport sometimes with the animals.

*Fusus antiquus*. The large form of this mollusc, with its fine white shell, measuring 7·5 to 8 inches in length, is said by Mr. Jeffreys to be "peculiar to the Cheshire coast." It is certainly fished by men from Menai Bridge on the way to Fleetwood, whither they take large quantities to be sold for bait. It would be a fit object for the Committee to aim at to find where this *Fusus*, our largest testaceous mollusc and our most beautiful shell, is actually at home, and to investigate the conditions of his life there.

*Fusus gracilis* is washed up abundantly on Red Wharf beach.

*Fusus propinquus* also.

*Fusus jeffreysianus* also has occurred on the same shore.

*Cylichna cylindracea*, Penn. Beach, Penmaenmawr and Southport.

*Actæon tornatilis*, L. Frequent on the beach (dead) at Penmaenmawr and Southport.

*Scaphander lignarius*, L. Beach, Red Wharf Bay and Southport.

## CEPHALOPODA.

*Ommastrephes* sp.? A fine specimen, taken 25 m. S.E. of Douglas Head, was brought quite fresh to the Liverpool Museum, in April, 1860 (T. J. Moore).

*Loligo media*, L., of which four specimens were captured on May 23rd off the Constable Bank, near Llandudno, during the cruise of the "Hyæna," is common in the Menai Straits, frequent in the dredge, and in the fishing wires, and not uncommon when the "seine" is drawn on Penmaenmawr sands on a summer evening. Dredged at Leasowe (T. J. Moore).

Bunches of spawn, differing from, but similar to, that of *L. vulgaris*, occur on Penmaenmawr beach.

*Loligo vulgaris*, L., is taken in the fishing wires in Menai Straits.

*Rossia macrosoma*, Delle Ch., has been taken alive at Southport after a S.W. storm; and has been found at Rhyl and Bagillt, by Mr. A. O. Walker. Also at Red Wharf Bay, Anglesey (D.). Also at New Brighton, and at Egremont (T. J. Moore).

*Sepia officinalis*, Linn. The shell is drifted on shore occasionally from Penmaenmawr to Southport. One individual was brought to the Liverpool Museum alive, twenty years ago. It swam in the tank with great rapidity, struck the end violently, and died immediately (T. J. Moore).

*Sepia biserialis* has been found at Southport. Mrs. Plant found a number of the shells at Cymmeran Bay, on the west coast of Anglesey.

*Octopus vulgaris*, Lmk. A large female was taken in the Albert Dock, Liverpool, September, 1854 (T. J. Moore).

*Eledone cirrosa*, Lam., is not infrequent amongst the stones at low water at Great Ormes Head. In 1885, one large specimen was found alive on Hilbre Island, and a

young specimen was dredged to the north of Puffin Island. It has been found several times at Colwyn Bay, by Mr. A. O. Walker. Found at Seacombe, and at New Brighton, and frequently brought to the Liverpool Museum alive by local fishermen (T. J. Moore).

*Sepiola atlantica*, D'Orb. Six specimens were dredged in the Menai Straits on May 24th, and one small specimen was obtained on May 25th, north of Puffin Island. One specimen was dredged off Point of Ayr in June. Frequent in the fishing wires in the Straits (A.). Frequently brought alive to the Liverpool Museum (T. J. Moore).

(3.)

## COMPARATIVE TABLE OF OCCURRENCE OF THE SPECIES.

### Explanation.

a. *abundant.* c. *common.* r. *rare.* i. *only occasional individuals.* D. *dead shells.* L. *living.* + *occurrence only.*

Menai Straits, Bridges to Penmaenmawr.—Dr. T. Alcock, R. D. D., and A. O. Walker.

North of Puffin Island, Redwharf Bay.—Prof. E. Forbes, *British Marine Zoology*, British Association, 1860, and R. D. D.

Liverpool,* including Dee Mouth.—Mr. Byerley, *Literary and Philosophical Society of Liverpool, Proceedings*, viii, 1853–4. Mr. T. J. Moore, Mr. F. Archer, and others.

Formby and Southport.—Mr. C. B. Brown, in Dr. Nichols' *Southport*, 1861, and *Naturalists' Scrap Book*, Liverpool. Dr. Alcock and R. D. D.

Blackpool and Fleetwood.—R. D. D.

Isle of Man (South).—Prof. Herdman.

Isle of Man (North).—Prof. E. Forbes, *Malacologia Monensis*.

Glacial Drift.—Moel Tryfaen and Blackpool, from Mr. Shone's paper, *Geological Soc. Q. J.*, May, 1878. *Liverpool and Wirral*, by Mr. G. H. Morton, F.G.S., and from Mr. Reade's paper, *Q. J. G. S.*, Feb., 1874.

* The indication of frequency in the Liverpool column is not of certainty, as Mr. Byerley's notes do not in every case deal with that question.

| MOLLUSCA. | Menai Straits, Bridges to Penmaenmawr. D | Menai Straits, Bridges to Penmaenmawr. L | North of Puffin Island. Redwharf Bay. D | North of Puffin Island. Redwharf Bay. L | Liverpool. D | Liverpool. L | Formby and Southport. D | Formby and Southport. L | Blackpool and Fleetwood. D | Blackpool and Fleetwood. L | Isle of Man (South). D | Isle of Man (South). L | Isle of Man (North). D | Isle of Man (North). L | D | L | Glacial Drift. Moel Tryfaen. | Glacial Drift. Blackpool. | Glacial Drift. Liverpool and Wirral. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAMELLIBRANCHIATA. | | | | | | | | | | | | | | | | | | | |
| *Anomia ephippium.* L. | c | c | + | + | + | | + | | | | | c | | + | | | | | |
| ,, *patelliformis.* L. | c | | + | + | | | | | | | | | | + | | | | | |
| *Ostrea edulis.* L. | c | c | + | + | | + | r | | r | | | | | + | | | + | + | + |
| *Pecten pusio.* L. | r | | + | | | | | | | | r | | | + | | | | | |
| ,, *varius.* L. | c | | c | + | + | | r | | r | r | | r | | + | | | | | |
| ,, *opercularis.* L. | c | c | c | + | | a | c | c | r | r | | r | | + | | | + | | + |
| ,, *tigrinus.* Müll. | r | | + | + | | | | | | | + | | | + | | | | | |
| ,, *septemradiatus.* Müll. | | | | | | | | | | | | | | | | | | | |
| ,, *testæ.* Biv. | | | | | | | | | | | | | | | | | | | |
| ,, *striatus.* Müll. | | | | | | | | | | | | | | | | | | | |
| ,, *similis.* Lask. | | | | | | | | | | | | | + | | | | | | |
| ,, *maximus.* L. | r | r | r | | r | | | c | r | | | r | | + | | | | | |
| *Lima sarsii.* Lov. | | | | | | | | | | | | | | | | | | | |
| ,, *elliptica.* Jeffr. | r | | + | | | | | | | | r | | | | | | | | |
| ,, *subauriculata.* Mont. | r | | | | | | | | | | r | | | + | | | | | |
| ,, *loscombii.* Sow. | | | + | | | | | | | | + | | | | | | | | |
| ,, *hians.* Gm. | | | + | | | | | | | | | | | + | | | | | |
| *Avicula hirundo.* L. | | | | | | | | | | | | | | | | | | | |
| *Pinna rudis.* L. | | | | | | | | | | | | | | | | | | | |
| *Mytilus edulis.* L. | a | a | r | + | | a | c | c | | | | c | | + | | | + | | + |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Mytilus modiolus*. L. - | c | c | r | + | | r | r | r | | | | | | + | | | + | | + |
| ,, *barbatus*. L. - | r | r | + | | | | r | r | | | | | | | | | | | |
| ,, *adriaticus*. Lmk. | | | | + | | | | r | | | | | | | | | | | |
| ,, *phaseolinus*. Phil. | | | | | | | | | | | | | | | | | | | |
| *Modiolaria marmorata*. Forb. | r | r | | + | + | | | | | | | r | | + | | | | | |
| ,, *costulata*. Riss. | | | | | | | | | | | | | | | | | | | |
| ,, *discors*. L. - | | | | + | | | | | | | | | | + | | | | | |
| ,, *nigra*. Gray - | | | | | | | | | | | | | | | | | | | |
| *Crenella rhombea*. Berk. - | | | | | | | | | | | | | | | | | | | |
| ,, *decussata*. Mont. - | | | | | | | | | | | | | | | | | | | |
| *Nucula sulcata*. Brown - | | | | | | | | | | | | | | | | | | | |
| ,, *nucleus*. L. - | c | c | + | c | c | | r | | | | | r | | + | | | | | |
| ,, *nitida*. Sow. - | | | | | r | | | | | | | | + | | | | | | |
| ,, *tenuis*. Mont. - | | | | | | | | | | | | | | | | | | | |
| *Leda pygmæa*. Münst. - | | | | | | | | | | | | | | | | | | | |
| ,, *minuta*. Müll. - | | | | | | | r | | | | | | | | | | | | + |
| *Limopsis aurita*. Brock. - | | | | | | | | | | | | | | | | | | | |
| *Pectunculus glycimeris*. L. | i | | r | + | | | | | | | | c | | + | | | + | | + |
| *Arca pectunculoides*. Sca. | | | | | | | | | | | | | | | | | | | |
| ,, *obliqua*. Phil. - | | | | | | | | | | | | | | | | | | | |
| ,, *lactea*. L. - - | | | + | | | | | | | | | | | | | | | | |
| ,, *tetragona*. Phi. - | | | | | | | | | | | | | | + | | | | | |
| *Galeomma turtoni*. Eds. - | | | | | | | | | | | | | | | | | | | |
| *Lepton squamosum*. Mont. | | | + | | | | | | | | | | | | | | | | |
| ,, *nitidum*. Turt. - | | | | | | | | | | | | | | | | | | | |
| ,, *sulcatulum*. Jeffr. - | | | | | | | | | | | | | | | | | | | |
| ,, *clarkiæ*. Cl. - | | | | | | | | | | | | | | | | | | | |
| *Montacuta substriata*. Mont. | | | | | | | | | | | | | | + | | | | | |

| | Menai Straits, Bridges to Penmaenmawr | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| LAMELLIBRANCHIATA—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Montacuta bidentata.* Mont. - | | | + | | | i | r | | | | | | | | | | | | |
| ,, *ferruginosa.* Mont. - | | | | | c | c | i | | | | | | | | | | | | |
| *Lasæa rubra.* Mont. - | | c | | + | | | | | | | | | | + | | | | | |
| *Kellia suborbicularis.* Mont. - | | | | + | | | | | | | | | | + | | | | | |
| *Loripes lacteus.* L. - | | | | | | | i | | | | | | | | | | | | |
| ,, *divaricatus.* L. - | | | | | | | | | | | | | | | | | | | |
| *Lucina spinifera.* Mont. - | | | | | | | | | | | | | | | | | | | |
| ,, *borealis.* L. - | | | + | | | | | | | | | | | + | | | | | |
| *Axinus flexuosus.* Mont. - | r | | | | | | i | | | | | | | | | | | | |
| ,, *croulinensis.* Jeffr. - | | | | | | | | | | | | | | | | | | | |
| Forb. - | | | | | | | | | | | | | | | | | | | |
| Mont. - | | | + | | | | | | | | | | | | | | | | |
| *Cyamium minutum.* Fabr. - | | | | | | | | | | | | | | + | | | | | |
| *Cardium aculeatum.* L. - | | | | | | | | | | | | | | | | | | | |
| ,, *echinatum.* L. - | c | r | c | | c | r | c | r | | | | | | + | | | + | + | + |
| ,, *tuberculatum.* L. - | | | | | | | | | | | | | | | | | | | + |
| ,, *papillosum.* Poli. - | | | | | | | | | | | | | | | | | | | |
| ,, *exiguum.* Gm. - | | | | | | | | | | | | | | | | | | | |
| ,, *fasciatum.* Mont. - | | | | | | | | | | | | | | + | | | + | | |
| ,, *nodosum.* Turt. - | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cardium edule.* L. | a | a | c | c | a | a | a | a | | | | | | + | | | + | + | + |
| ,, *minimum.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *norvegicum.* Speng. | r | r | + | | | | r | | | | | r | | + | | | + | | |
| *Isocardia cor.* L. | | | | | | | | | | | | | | | | | | | |
| *Cyprina islandica.* L. | r | r | + | | r | | r | | | | | | | + | | | + | + | + |
| *Astarte sulcata.* Da C. | | | | + | | | | | | | | r | | + | | | + | + | + |
| ,, *compressa.* Mont. | | | | | | | | | | | | | | | | | + | | + |
| ,, *triangularis.* Mont. | | | | + | | | | | | | | | | + | | | | | |
| *Circe minima.* Mont. | | r | | | | | | | | | | | | | | | + | | |
| *Venus exoleta.* L. | r | | r | | r | | r | | | | + | | | + | | | | | + |
| ,, *lincta.* Pult. | r | r | r | | | | r | | | | | | | + | | | | | + |
| ,, *chione.* L. | | | | | | | | | | | | | | | | | + | | + |
| ,, *fasciata.* Da C. | | r | | + | i | | | | | | | | | + | | | | | |
| ,, *casina.* L. | | | | + | | | | | | | | c | | + | | | | | |
| ,, *verrucosa.* L. | | | | | | | | | | | | | | | | | | | |
| ,, *ovata.* Penn. | | r | r | + | r | r | i | | | | | | | + | | | | | |
| ,, *gallina.* L. | a | a | a | a | . | a | c | c | c | c | | c | | + | | | + | + | + |
| *Tapes aureus.* Gm. | | | | | | | | | | | | | | | | | | | |
| ,, *virgineus.* L. | i | i | | + | | | | | | | | r | | + | | | + | | + |
| ,, *pullastra.* Mont. | c | | + | | c | c | | | | | | | | + | | | | | |
| ,, *decussatus.* L. | r | | + | | i | | | | | | | | | | | | | | |
| *Lucinopsis undata.* Penn. | r | | r | | | | r | | | | | | + | + | | | | | |
| *Gastrana fragilis.* L. | | | | | | | | | | | | | | | | | | | |
| *Tellina balaustina.* L. | | | | | | | | | | | | | | | | | | | |
| ,, *crassa.* Penn. | | | + | | | | | | | | | | | + | | | | | |
| ,, *balthica.* L. | a | c | + | a | a | a | a | c | | | | r | | + | | | + | + | + |
| ,, *tenuis.* Da C. | c | | + | a | c | c | c | | | | r | | | + | | | | | |
| ,, *fabula.* Gron. | c | | + | a | c | c | c | | | | | | | | | | | | |

| | Menai Straits, Bridges to Penmaenmawr. | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| LAMELLIBRANCHIATA—*continued*. | | | | | | | | | | | | | | | | | | | |
| *Tellina squalida*. Pult. | | | | | | | | | | | | | | | | | | | |
| ,, *donacina*. Don. | r | r | + | | | r | i | | | | | | | | | | | | |
| ,, *pusilla*. Phil. | | i | | | | | | | | | | | | | | | | | + |
| *Psammobia tellinella*. Lmk. | | r | | | | | | | | | | | | + | | | | | |
| ,, *costulata*. Turt. | | | | | | | | | | | | | | | | | | | |
| ,, *ferroensis*. Chem. | r | r | r | + | c | | r | r | r | | | | | + | | | | | + |
| ,, *vespertina*. Chem. | | | | | | | | | | | | | | | | | | | |
| *Donax vittatus*. Da C. | c | c | c | | a | a | c | c | c | c | | | | + | | | + | | + |
| ,, *trunculus*. L. | | | | + | | | | | | | | | | | | | | | |
| ,, *politus*. Poli. | | | | | | | | | | | | | | | | | | | |
| *Amphidesma castaneum*. Mont. | | | | | | | | | | | | | | | | | | | |
| *Mactra solida*. L. | c | c | r | | c | c | c | | c | | | c | | + | | | + | + | + |
| ,, *subtruncata*. Da C. | r | r | r | + | r | r | r | r | r | r | | | | + | | | | + | + |
| ,, *stultorum*. L. | c | c | c | | c | c | a | a | | a | | | | | | | | | |
| ,, *glauca*. Born. | | | | | | | | | | | | | | | | | | | |
| *Lutraria elliptica*. Lmk. | c | | + | | r | | c | i | | | | | + | | | | | | + |
| ,, *oblonga*. Chem. | | | | | | | | | | | | | | | | | | | |
| *Scrobicularia prismatica*. Mont. | | r | + | | | | | | | | | | | + | | | | | |
| ,, *nitida*. Müll. | | | | | | | | | | | | | | | | | | | |
| ,, *alba*. Wood. | a | a | a | a | | a | c | c | | | | | | + | | | | | + |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Scrobicularia tenuis.* Mont. - | | | | | | | | | | | | | | + | | | | | |
| ,, *piperata.* Gm. - | c | | | | | a | r | r | | | | | | | | | | | + |
| *Solecurtus candidus.* Ren. - | | | | | | | i | | | | | | + | | | | | | |
| ,, *antiquatus.* Pult. - | | | | | | | i | | | | | | | + | | | | | |
| *Ceratisolen legumen.* L. - | c | c | c | | a | | c | c | c | c | | | | | | | | | |
| *Solen pellucidus.* Penn. - | r | r | | + | r | | r | r | | | | | | + | | | | | |
| ,, *ensis.* L. - | c | c | c | + | a | | a | a | c | c | | | + | + | | | | | |
| ,, *siliqua.* L. - | i | | r | | r | | r | | | | | | | + | | | | | |
| ,, *vagina.* L. - | c | c | | | | | r | | | | | | | | | | | | |
| *Pandora inæquivalvis.* L. - | | | | | | | | | | | | | | | | | | | |
| *Lyonsia norvegica.* Chem. - | | | | + | | | | | | | | | | | | | | | |
| *Thracia prætenuis.* Pult. - | | | | | | | | | | | | i | | | | | | | |
| ,, *papyracea.* Poli. - | c | c | c | | | | c | c | c | | | | | | | | | | |
| ,, *pubescens.* Pult. - | | | | | | | | | | | | | | | | | | | |
| ,, *convexa.* W. Wood - | | | | | | | r | | | | | | | | | | | | |
| ,, *distorta.* Mont. - | | | | | | | | | | | | | | + | | | | | |
| *Poromya granulata.* Nyst. - | | | | | | | | | | | | | | | | | | | |
| *Neæra abbreviata.* Forbes. - | | | | | | | | | | | | | | | | | | | |
| ,, *costellata.* Desh. - | | | | | | | | | | | | | | | | | | | |
| ,, *cuspidata.* Olivi. - | | | | | | | | | | | | | | | | | | | |
| *Corbula gibba.* Olivi. - | r | r | r | + | | a | c | r | | | | | | + | | | + | + | |
| *Mya arenaria.* L. - | | | | | r | i | r | i | | | | | | | | | | | |
| ,, *truncata.* L. - | a | a | c | | c | a | c | r | | | | | | + | | | + | + | + |
| ,, *binghami.* Turt. - | | r | | | | | | | | | | | | + | | | | | |
| *Panopæa plicata.* Mont. - | | | | | | | | | | | | | | | | | | | |
| *Saxicava norvegica.* Speng. - | | | | | | | | | | | | | | | | | | | + |
| ,, *rugosa.* L. - | | a | | + | r | r | | r | | | | c | | + | | | + | | + |
| *Venerupis irus.* L. - | | | | | | | | | | | | | | | | | | | |

| | Menai Straits, Bridges to Penmaenmawr. | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| **Lamellibranchiata**—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Gastrochæna dubia.* Penn. - | | | | | | | | | | | | | | | | | | | |
| *Pholas dactylus.* L. - | | | | | | | | | | | | | | | | | | | |
| ,, *candida.* L. - | c | c | r | | | a | a | r | | c | | | | | | | | | + |
| ,, *parva.* Penn. - | | | | | | | | | | | | | | | | | | | |
| ,, *crispata.* L. - | r | r | + | | | a | i | | | | | | + | | | | | | + |
| *Pholadidea papyracea.* Turt. - | | | | | i | | | | | | | | | | | | | | |
| *Xylophaga dorsalis.* Turt. - | | | | | | | | | | | | | | | | | | | |
| *Teredo norvegica.* Speng. - | | | | | | | | | | | | | | | | | | | |
| ,, *navalis.* L. - | | | | | | | | | | | | | | | | | | | |
| ,, *pedicellata.* Quat. - | | | | | | | | | | | | | | | | | | | |
| ,, *megotara.* Han. - | | | | | | | | | | | | | | | | | | | |
| ,, *malleolus.* Turt. - | | | | | | | | | | | | | | | | | | | |
| ,, *bipinnata.* Turt. - | | | | | | | | | | | | | | | | | | | |
| **Scaphopoda.** | | | | | | | | | | | | | | | | | | | |
| *Siphodentalium lofotense.* Sars. - | | | | | | | | | | | | | | | | | | | |
| *Cadulus subfusiformis.* Sars. - | | | | | | | | | | | | | | | | | | | |
| ,, *jeffreysi.* Mont. - | | | | | | | | | | | | | | | | | | | |
| *Dentalium entale.* L. - | r | | r | | r | | r | | | | | r | | + | | | + | | + |
| ,, *tarentinum.* Lmk. - | | | | | | | r | | | | | | | | | | | | + |
| ,, *abyssorum.* Sars. - | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLYPLACOPHORA. | | | | | | | | | | | | | | | | | | | |
| *Chiton fascicularis.* L. | | c | | c | | | | | | r | | | | + | | | | | |
| ,, *discrepans.* Bro. | | | | | | | | | | | | | | | | | | | |
| ,, *hanleyi.* Bean. | | | | | | | | | | | | | | | | | | | |
| ,, *cancellatus.* G. B. Sow. | | r | | | | | | | | | | r | | + | | | | | |
| ,, *scabridus.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *cinereus.* L. | | c | | | | c | | | | c | | c | | | | | | | |
| ,, *albus.* L. | | r | | | | | | | | | | r | | | | | | | |
| ,, *marginatus.* Penn. | | | | | | | | | | | | | | | | | | | |
| ,, *ruber.* Lowe | | | | | | | | | | | | | | + | | | | | |
| ,, *lævis* Mont. | | r | | | | | | | | | | r | | + | | | | | |
| ,, *marmoreus.* Fabr. | | r | | | | | | | | | | | | | | | | | |
| GASTROPODA. | | | | | | | | | | | | | | | | | | | |
| *Patella vulgata.* L. | | a | | a | | c | r | | | | | a | | + | | | | | |
| *Helcion pellucidum.* L. | | c | | | | | | | | | | c | | + | | | | | |
| *Tectura testudinalis.* Müll. | | | | | | | | | | l | | | | + | | | | | |
| ,, *virginea.* Müll. | | | | | | | | | | | | | | + | | | | | |
| ,, *fulva.* Müll. | | | | | | | | | | | | | | | | | | | |
| *Lepeta cœca.* Müll. | | | | | | | | | | | | | | | | | | | |
| *Propilidium ancyloides.* Forbes | | | | | | | | | | | | | | | | | | | |
| *Puncturella noachina.* L. | | | | | | | | | | | | | | | | | | | |
| *Emarginula fissura.* L. | | | | | | | | | | | | c | | + | | | | | |
| ,, *rosea.* Bell | r | | | | | | r | | | | | | | | | | | | |
| ,, *crassa.* J. Sow. | | | | | | | | | | | | | | | | | | | |
| ,, *cancellata.* Ph. | | | | | | | | | | | | | | | | | | | |
| *Fissurella græca.* L. | | | | | | | | | | | | r | | + | | | + | | |
| *Capulus hungaricus.* L. | i | | + | | | | | | | | | | | + | | | | | |

| | Menai Straits, Bridges to Penmaenmawr. | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| **Gastropoda**—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Calyptræa chinensis.* L. | | | | | | | | | | | | | | | | | | | |
| *Haliotis tuberculata.* L. | | | | | | | | | | | | | | | | | | | |
| *Scissurella crispata.* Flem. | | | | | | | | | | | | | | | | | | | |
| *Cyclostrema cutlerianum.* Cl. | | | | | | | | | | | | | | | | | | | |
| ,, *nitens.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *serpuloides.* Mont. | | | | | | | | | | | | | | | | | | | |
| *Trochus helicinus.* Fabr. | | | | | | | | | | | | | | | | | | | |
| ,, *grœnlandicus.* Chem. | | | | | | | | | | | | | | | | | | | |
| ,, *glaucus.* Müll | | | | | | | | | | | | | | | | | | | |
| ,, *amabilis.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *magus.* L. | r | | | | | | r | | | | | c | | + | | | | | |
| ,, *tumidus.* Mont. | r | | | + | | | | | | | | r | | + | | | | | |
| ,, *cinerarius.* L. | c | c | | + | | c | r | | | | | c | | + | | | | | |
| ,, *umbilicatus.* Mont. | | c | | | i | | | | | c | | | | + | | | | | |
| ,, *duminyi.* Req. | | | | | | | | | | | | | | | | | | | |
| ,, *lineatus.* Da C. | | | | | | | | | | | | | | | | | | | |
| ,, *montacuti.* W. Wood | | | + | | | | | | | | | | | + | | | | | |
| ,, *striatus.* L. | | | | | | | | | | | | | | + | | | | | |
| ,, *exasperatus.* Penn. | | | | | | | | | | | | | | | | | | | |
| ,, *millegranus.* Phil. | | | + | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Trochus granulatus.* Born. | | | | | | | | | | | | | | + | | | | | |
| ,, *zizyphinus.* L. | c | c | | + | c | c | r | r | c | c | | c | | + | | | | | |
| ,, *occidentalis.* Migh. | | | | | | | | | | | | | | | | | | | |
| *Phasianella pullus.* L. | | r | + | | | | r | | | | | i | | + | | | | | |
| *Lacuna crassior.* Mont. | | | | | | c | | | | | | | | | | | | | |
| ,, *divaricata.* Fabr. | | | | | i | | | | | | | a | | + | | | + | | + |
| ,, *puteolus* Turt. | | | | | | | | | | | | | | | | | | | |
| ,, *pallidula.* Da C. | | | | | | | | | | | | | | + | | | | | |
| *Littorina obtusata.* L. | | a | | | | c | | | | a | | a | | + | | | | + | |
| ,, *neritoides.* L. | | | | | | | | | | | | | | | | | | | |
| ,, *rudis.* Maton. | | a | | | | c | | | | a | | a | | + | | | + | + | |
| ,, *littorea.* L. | | a | | | | a | | | | a | | a | | + | | | + | | + |
| *Rissoa striatula.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *lactea.* Mich. | | | | | | | | | | | | | | | | | | | |
| ,, *cancellata.* Da C. | | | | | | | | | | | | | | | | | | | |
| ,, *calathus.* F. and H. | | | | | | | | | | | | | | | | | | | |
| ,, *reticulata.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *cimicoides* Forbes | | | | | | | | | | | | | | | | | | | |
| ,, *jeffreysi.* Wall. | | | | | | | | | | | | | | | | | | | |
| ,, *punctura.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *abyssicola.* Forb. | | | | | | | | | | | | | | | | | | | |
| ,, *zetlandica.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *costata.* Ad. | | | + | | | | | | | | | | | | | | | | |
| ,, *parva.* Da C. | | | | | | | | | | | | | + | + | | | | | |
| ,, *inconspicua.* Ald. | | | | | | | | | | | | | | | | | | | |
| ,, *albella.* Lowe | | | | | | | | | | | | | | | | | | | |
| ,, *membranacea.* Ad. | | | | | | | | | | | | | | | | | | | |
| ,, *violacea.* Desm. | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| **Gastropoda**—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Calyptræa chinensis.* L. - | | | | | | | | | | | | | | | | | | | |
| *Haliotis tuberculata.* L. - | | | | | | | | | | | | | | | | | | | |
| *Scissurella crispata.* Flem. - | | | | | | | | | | | | | | | | | | | |
| *Cyclostrema cutlerianum.* Cl. - | | | | | | | | | | | | | | | | | | | |
| ,, *nitens.* Phil. - | | | | | | | | | | | | | | | | | | | |
| ,, *serpuloides.* Mont. - | | | | | | | | | | | | | | | | | | | |
| *Trochus helicinus.* Fabr. - | | | | | | | | | | | | | | | | | | | |
| ,, *grœnlandicus.* Chem. - | | | | | | | | | | | | | | | | | | | |
| ,, *glaucus.* Müll - | | | | | | | | | | | | | | | | | | | |
| ,, *amabilis.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *magus.* L. - | r | | | | | | r | | | | | c | | + | | | | | |
| ,, *tumidus.* Mont. - | r | | | + | | | | | | | | r | | + | | | | | |
| ,, *cinerarius.* L. - | c | c | | + | | c | r | | | | | c | | + | | | | | |
| ,, *umbilicatus.* Mont. - | | c | | | i | | | | | c | | | | + | | | | | |
| ,, *duminyi.* Req. - | | | | | | | | | | | | | | | | | | | |
| ,, *lineatus.* Da C. - | | | | | | | | | | | | | | | | | | | |
| ,, *montacuti.* W. Wood - | | | + | | | | | | | | | | | + | | | | | |
| ,, *striatus.* L. - | | | | | | | | | | | | | | + | | | | | |
| ,, *exasperatus.* Penn. - | | | | | | | | | | | | | | | | | | | |
| ,, *millegranus.* Phil. - | | | + | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Trochus granulatus.* Born. | | | | | | | | | | | | | | + | | | | | |
| ,, *zizyphinus.* L. | c | c | | + | c | c | r | r | c | c | | c | | + | | | | | |
| ,, *occidentalis.* Migh. | | | | | | | | | | | | | | | | | | | |
| *Phasianella pullus.* L. | | r | + | | | | r | | | | | i | | + | | | | | |
| *Lacuna crassior.* Mont. | | | | | | c | | | | | | | | | | | | | |
| ,, *divaricata.* Fabr. | | | | | i | | | | | | | a | | + | | | + | | + |
| ,, *puteolus* Turt. | | | | | | | | | | | | | | | | | | | |
| ,, *pallidula.* Da C. | | | | | | | | | | | | | | + | | | | | |
| *Littorina obtusata.* L. | | a | | | | c | | | | a | | a | | + | | | | + | |
| ,, *neritoides.* L. | | | | | | | | | | | | | | | | | | | |
| ,, *rudis.* Maton. | | a | | | | c | | | | a | | a | | + | | | + | + | |
| ,, *littorea.* L. | | a | | | | a | | | | a | | a | | + | | | + | | + |
| *Rissoa striatula.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *lactea.* Mich. | | | | | | | | | | | | | | | | | | | |
| ,, *cancellata.* Da C. | | | | | | | | | | | | | | | | | | | |
| ,, *calathus.* F. and H. | | | | | | | | | | | | | | | | | | | |
| ,, *reticulata.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *cimicoides* Forbes | | | | | | | | | | | | | | | | | | | |
| ,, *jeffreysi.* Wall. | | | | | | | | | | | | | | | | | | | |
| ,, *punctura.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *abyssicola.* Forb. | | | | | | | | | | | | | | | | | | | |
| ,, *zetlandica.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *costata.* Ad. | | | + | | | | | | | | | | | | | | | | |
| ,, *parva.* Da C. | | | | | | | | | | | | | + | + | | | | | |
| ,, *inconspicua.* Ald. | | | | | | | | | | | | | | | | | | | |
| ,, *albella.* Lowe | | | | | | | | | | | | | | | | | | | |
| ,, *membranacea.* Ad. | | | | | | | | | | | | | | | | | | | |
| ,, *violacea.* Desm. | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Try-faen. | Black-pool. | Liver-pool and Wirral. |
| GASTROPODA—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Rissoa costulata.* Ald. - | | | | | | | | | | | | | | | | | | | |
| ,, *striata.* Ad. - | | | + | | | | r | | | | | | | + | | | | | |
| ,, *proxima.* Ald. - | | | | | | | | | | | | | | | | | | | |
| ,, *vitrea.* Mont. - | | | | | r | | | | | | | | | | | | | | |
| ,, *pulcherrima.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *fulgida.* Ad. - | | | | | | | | | | | | | | | | | | | |
| ,, *soluta.* Phil. - | | | | | | | | | | | | | | | | | | | |
| ,, *semistriata.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *cingillus.* Mont. - | | | | | | | r | | | | | | | + | | | | | |
| *Hydrobia ulvæ.* Penn. - | | | | | | a | a | a | | | | | | | | | | | |
| ,, *ventrosa.* Mont. | | | | | | | | | | | | | | | | | | | |
| *Barleeia rubra* Mont. - | | | | | | | | | | | | | | | | | | | |
| *Jeffreysia diaphana.* Ald. | | | | | | | | | | | | | | | | | | | |
| ,, *opalina.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *globularis.* Jeff. | | | | | | | | | | | | | | | | | | | |
| *Skenea planorbis.* Fabr. - | | | | | | | | | | | | | | + | | | | | |
| *Homalogyra atomus.* Phil. | | | | | | | | | | | | | | + | | | | | |
| ,, *rota.* F. and H. | | | | | | | | | | | | | | | | | | | |
| *Cœcum trachea.* Mont. - | | | | | | | | | | | | | | | | | | | |
| ,, *glabrum.* Mont. - | | | | | | | | | | | | | | | | | | | |

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| *Turritella terebra.* L. | c | | | | a | | c | | c | | | | | + | | | + | | + |
| *Truncatella truncatula.* Drap. | | | | | | | | | | | | | | | | | | | |
| *Scalaria turtonæ.* Turt. | r | | | | r | | r | | r | | | | | | | | | | |
| ,, *communis.* Lmk. | r | | | | r | | c | | r | | | | | | | | | | |
| ,, *trevelyana.* Leach. | | | | | | | | | | | | | | | | | | | |
| ,, *clathratula.* Ad. | | | | | | | | | | | | | | | | | | | |
| *Aclis unica.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *ascaris.* Turt. | | | | | | | | | | | | | | | | | | | |
| ,, *supranitida.* S. Wood. | | | | | | | r | | | | | | | | | | | | |
| ,, *walleri.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *gulsonæ.* Cl. | | | | | | | | | | | | | | | | | | | |
| *Odostomia minima.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *nivosa.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *truncatula.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *clavula.* Lov. | | | | | | | | | | | | | | | | | | | |
| ,, *lukisi.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *albella.* Lov. | | | | | | | | | | | | | | | | | | | |
| ,, *rissoides.* Han. | | | | | | | | | | | | | | | | | | | |
| ,, *pallida.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *conoidea.* Bron. | | | | | | | | | | | | | | | | | | | |
| ,, *umbilicaris.* Malm. | | | | | | | | | | | | | | | | | | | |
| ,, *acuta.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *conspicua.* Ald. | | | | | | | | | | | | | | | | | | | |
| ,, *unidentata.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *turrita.* Han. | | | | | | | | | | | | | | | | | | | |
| ,, *plicata.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *insculpta.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *diaphana.* Jeff. | | | | | | | | | | | | | | | | | | | |

| | Menai Straits, Bridges to Penmaenmawr. | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
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| GASTROPODA—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Odostomia obliqua.* Ald. | | | | | | | | | | | | | | | | | | | |
| ,, *warreni.* Thomp. | | | | | | | | | | | | | | | | | | | |
| ,, *dolioliformis.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *decussata.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *clathrata.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *indistincta.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *interstincta.* Mont. | | | | | | | i | | | | | | | | | | | | |
| ,, *spiralis.* Mont. | | | | | | | | | | | | | | + | | | | | |
| ,, *eximia.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *fenestrata.* Forbes. | | | | | | | | | | | | | | | | | | | |
| ,, *excavata.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *scalaris.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *rufa.* Phil. | | | | | | | r | | | | | | | | | | | | |
| ,, *lactea.* L. | | | | | | | i | | | | | | | + | | | | | |
| ,, *pusilla.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *scillæ.* Scac. | | | | | | | | | | | | | | | | | | | |
| ,, *acicula.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *nitidissima.* Mont. | | | | | | | | | | | | | | | | | | | |
| *Ianthina rotundata.* Leach. | | | | | | | | | | | | | | | | | | | |
| *Stylifer turtonæ.* Brod. | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Eulima polita.* L. - | | | | | r | | i | | | | | | + | | | | | | |
| ,, *intermedia.* Can. - | | | | | | | | | | | | | | | | | | | |
| ,, *distorta.* Desh. - | | | | | | | | | | | | | + | | | | | | |
| ,, *stenostoma.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *subulata.* Don. - | | | | | r | | r | | | | | | | + | | | | | |
| ,, *bilineata.* Ald. - | | | | | | | | | | | | | | | | | | | |
| *Natica islandica.* Gm. - | | | | | | | | | | | | | | | | | | | |
| ,, *grœnlandica.* Back. | | | | | | | | | | | | | | | | | | | + |
| ,, *sordida.* Phil. - | | | | | | | | | | | | | | | | | | | |
| ,, *catena.* Da C. - | c | c | | | | a | c | c | | | | r | | + | | | | + | |
| ,, *alderi.* Forbes. - | | c | | + | r | | r | r | | | | r | | + | | | | | |
| ,, *montacuti.* Forbes. | | | | | | | | | | | | | | + | | | | | |
| *Adeorbis subcarinatus.* Mont. | | | | | | | | | | | | | | | | | | | |
| *Lamellaria perspicua.* L. - | | i | | | | | | | | | | | + | + | | | | | |
| *Velutina plicatilis.* Müll. - | | | | | | | | | | | | | | | | | | | |
| ,, *lævigata.* Penn. - | | | + | | | | | | | | | r | | + | | | | | |
| *Torellia vestita* - - | | | | | | | | | | | | | | | | | | | |
| *Trichotropis borealis.* Brod. | | | | | | | | | | | | | | | | | + | | |
| *Aporrhais pespelicani.* L. - | r | r | | | r | | r | | r | | | r | | + | | | + | + | + |
| ,, *macandreæ.* Jeff. | | | | | | | | | | | | | | | | | | | |
| *Cerithium metula.* Lov. - | | | | | | | | | | | | | | | | | | | |
| ,, *reticulatum.* Da C. | r | | | | | | | | | | | | | | | | | | |
| ,, *perversum.* L. | | | | | | | | | | | | | | | | | | | |
| *Cerithiopsis tuberculata.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *barleei.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *pulchella.* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *metaxæ.* D. Ch. | | | | | | | | | | | | | | | | | | | |
| ,, *costulata.* Müll. | | | | | | | | | | | | | | | | | | | |

| | Menai Straits, Bridges to Penmaenmawr. | | North of Puffin Island, Redwharf Bay. | | Liverpool. | | Formby and Southport. | | Blackpool and Fleetwood. | | Isle of Man (South). | | Isle of Man (North). | | | | Glacial Drift. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| GASTROPODA—*continued*. | | | | | | | | | | | | | | | | | | | |
| *Purpura lapillus*. L. | r | a | | + | r | | r | | r | r | | c | | + | | | + | + | + |
| *Buccinum undatum*. L. | c | c | c | c | | a | c | c | | | | r | | + | | | + | + | + |
| ,, *humphreysianum*. Ben. | | | | | | | | | | | | | | | | | | | |
| *Buccinopsis dalei*. J. Sow. | | | | | | | | | | | | | | | | | | | |
| *Triton nodifer*. Lmk. | | | | | | | | | | | | | | | | | | | |
| ,, *cutaceus*. L. | | | | | | | | | | | | | | | | | | | |
| *Murex erinaceus*. L. | r | | | + | r | | r | | r | | | r | | + | | | + | + | + |
| ,, *aciculatus*. Lmk. | | | | | | | | | | | | | | | | | | | |
| *Lachesis minima*. Mont. | | | | | | | | | | | | | | | | | | | |
| *Trophon muricatus*. Mont. | | | + | | | | i | | | | | + | | + | | | | | |
| ,, *barvicensis*. Johnst. | | | | | | | i | | | | | + | | | | | + | | |
| ,, *truncatus*. Str. | r | | | | | | r | | r | | | | | + | | | + | + | + |
| *Fusus antiquus*. L. | | c | c | + | c | c | c | c | c | | | r | | + | | | + | + | + |
| ,, *norvegicus*. Chem. | | | | | | | | | | | | | | | | | | | |
| ,, *turtoni*. Bean. | | | | | | | | | | | | | | | | | | | |
| ,, *islandicus*. Chem. | | | | | | | | | | | | | | | | | | | |
| ,, *gracilis*. Da C. | r | | c | | | | r | | r | | r | | | + | | | + | | + |
| ,, *propinquus*. Ald. | i | | | | | | | | i | | | | | | | | | | |
| ,, *buccinatus*. Lmk. | i | | | | | | | | | | | | | | | | | | |
| ,, *berniciensis*. King | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Fusus fenestratus* Turt. - | | | | | | | | | | | | | | | | | | | |
| *Nassa reticulata.* L. - | r | | | | r | | | | r | | | | | + | | | + | + | + |
| „ *nitida.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| „ *incrassata.* Str. - | r | | | + | | | r | | | | | | | + | | | + | | + |
| „ *pygmæa.* Lmk. - | | | | | | | | | | | | | | | | | | | |
| *Columbella haliæeti.* Jeff. | | | | | | | | | | | | | | | | | | | |
| „ *nana.* Lov. - | | | | | | | | | | | | | | | | | | | |
| *Defrancia teres.* Forbes - | | | | | | | | | | | | | | | | | | | |
| „ *gracilis.* Mont. | | | + | | | | i | | | | | | | | | | | | |
| „ *leufroyi.* Mich. | | | | | | | | | | | | | | | | | | | |
| „ *linearis.* Mont. | | | | | | | | | | | | | | + | | | | | |
| „ *reticulata.* Ren. | | | | | | | | | | | | | | | | | | | |
| „ *purpurea.* Mont. | | | | | | | | | | | | | | + | | | | | |
| *Pleurotoma striolata.* Sca. | | | | | | | | | | | | | | | | | | | |
| „ *attenuata.* Mont. | | | | | | | | | | | | | | | | | | | |
| „ *costata.* Don. - | | | | | | | | | | | | | | | | | | | |
| „ *rugulosa.* Phil. | | | | | | | | | | | | | | | | | | | |
| „ *brachystoma.* Phil. | | | | | | | | | | | | | | | | | | | |
| „ *nebula.* Mont. | r | | | | | | | | | | | r | | | | | + | | |
| „ *lævigata.* Phil. | | | | | | | | | | | | | | | | | | | |
| „ *nivalis.* Lov. - | | | | | | | | | | | | | | | | | | | |
| „ *carinata.* Biv. | | | | | | | | | | | | | | | | | | | |
| „ *septangularis.* Mont. | | | + | | | | | | | | | | | | | | | | |
| „ *rufa.* Mont. - | | | | + | c | c | | | | | | | | + | | | + | | + |
| „ *turricula.* Mont. | r | | + | | c | c | | | | | | r | | + | | | + | | + |
| „ *trevelyana.* Flem. | | | | | | | | | | | | | | | | | | | + |
| *Marginella lævis.* Don. - | | | | | | | | | | | | | | | | | | | |
| *Cypræa europæa.* Mont. - | r | | | | r | | r | | | | | r | + | + | | | | + | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | L | D | L | D | L | L | D | D | L | D | L | D | L | D | L | Moel Tryfaen. | Blackpool. | Liverpool and Wirral. |
| GASTROPODA—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Ovula patula.* Penn. - | | | | | | | | | | | | | | | | | | | |
| *Cylichna acuminata.* Brug. | | | | | | | | | | | | | | | | | | | |
| ,, *nitidula.* Lov. - | | | | | | | | | | | | | | | | | | | |
| ,, *umbilicata.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *cylindracea.* Penn. | r | | | | r | | r | | | | | | | | | | | | |
| ,, *alba.* Bro. - | | | | | | | | | | | | | | | | | | | |
| *Utriculus mammillatus.* Phil. | | | | | | | | | | | | | | | | | | | |
| ,, *truncatulus.* Brug. | | | | | | | | | | | | | | | | | | | |
| ,, *obtusus.* Mont. - | | | | | a | | r | r | | | | | | | | | | | |
| ,, *ventrosus.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *expansus.* Jeff. - | | | | | | | | | | | | | | | | | | | |
| ,, *hyalinus.* Turt. - | | | | | | | | | | | | | | | | | | | |
| *Acera bullata.* Müll. - | | | | | | | | | | | | | | | | | | | |
| *Actæon tornatilis.* L. - | r | | | | r | | a | | | | | | | | | | | | |
| *Bulla hydatis.* L. - | | | | | | | | | | | | | | | | | | | |
| ,, *utriculus.* Broc. - | | | | | | | | | | | | | | | | | | | |
| *Scaphander lignarius.* L. - | r | | r | + | i | | r | | | | | | | r | | | | | |
| *Philine scabra.* Müll. - | | | | | | | | | | | | | | | | | | | |
| ,, *catena.* Mont. - | | | | | | | | | | | | | | | | | | | |
| ,, *angulata.* Jeff. - | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Philine quadrata.* S. Wood | | | | | | | | | | | | | | | | | | | |
| ,, *punctata.* Cl. | | | | | | | | | | | | | | | | | | | |
| ,, *pruinosa.* Cl. | | | | | | | | | | | | | | | | | | | |
| ,, *nitida* Jeff. | | | | | | | | | | | | | | | | | | | |
| ,, *aperta.* L. | | r | | | c | r | c | c | | | | | | + | | | | | |
| *Aplysia punctata.* Cuv. | | | | | | | | | | | | c | | | | | | | |
| ,, *depilans.* L. | | | | | | | | | | | | | | | | | | | |
| *Pleurobranchus membranaceus.* Mont. | | | | | | | | | | | | c | | | | | | | |
| ,, *plumula.* Mont. | | | | | | | | | | | | | | | | | | | |
| [NUDIBRANCHIATA omitted.*] | | | | | | | | | | | | | | | | | | | |
| **PULMONOBRANCHIATA.** | | | | | | | | | | | | | | | | | | | |
| *Oncidium celticum.* Cuv. | | | | | | | | | | | | | | | | | | | |
| *Assiminea grayana.* Leach. | | | | | | | | | | | | | | | | | | | |
| ,, *littorina.* D. Ch. | | | | | | | | | | | | | | | | | | | |
| *Melampus bidentatus.* Mont. | | | | | | | | | | | | | | | | | | | |
| ,, *myosotis.* Drap. | | | | | | | | | | | | | | | | | | | |
| *Otina otis.* Turt. | | | | | | | | | | | | | | + | | | | | |
| **PTEROPODA.** | | | | | | | | | | | | | | | | | | | |
| *Spirialis retroversus.* Flem. | | | | | | | | | | | | | | | | | | | |
| *Clio pyramidata.* Br. | | | | | | | | | | | | | | | | | | | |
| **CEPHALOPODA.** | | | | | | | | | | | | | | | | | | | |
| *Ommatostrephes sagittatus.* Lmk. | | | | | | | | | | | | | | | | | | | |
| *Illex coindetii.* Ver. | | | | | | | | | | | | | | | | | | | |
| *Loligo vulgaris.* Lmk. | | r | | | | | | | | | | | | r | | | | | |

* See separate Report, p. 267.—ED.

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| | D | L | D | L | D | L | D | L | D | L | D | L | D | L | D | L | Moel Try-faen. | Black-pool. | Liver-pool and Wirral. |
| CEPHALOPODA—*continued.* | | | | | | | | | | | | | | | | | | | |
| *Loligo media.* L. | | r | | | | | | | | | | | | | | | | | |
| *Rossia macrosoma.* D. Ch. | | | | | | r | | | | | | | | | | | | | |
| ,, *papillifera.* Jeff. | | | | | | | | i | | | | | | | | | | | |
| ,, *oweni.* Ball. | | | | | | | | | | | | | | | | | | | |
| *Sepiola atlantica.* D'Orb. | | c | | | | a | | | | | | | | | | | | | |
| *Sepia officinalis.* L. | | | | | r | r | i | | | | | | r | | | | | | |
| ,, *elegans.* D'Orb. | | | | | | | | | | | | | | | | | | | |
| ,, *biserialis.* De Mont. | | | | | | | i | | | | | | | | | | | | |
| *Octopus vulgaris.* Lmk. | | | | | | | | | | | | | | | | | | | |
| *Eledone cirrosa.* Lmk. | | r | | | | r | | | | | | | | r | | | | | |
| *Leda pernula* | | | | | | | | | | | | | | | | | + | | + |
| *Astarte borealis*, Chem. | | | | | | | | | | | | | | | | | | | + |
| *Natica affinis*, Gm. | | | | | | | | | | | | | | | | | | | + |
| *Fusus antiquus*, var. *contrarius* | | | | | | | | | | | | | | | | | | | + |
| ,, ,, ,, *despectus* | | | | | | | | | | | | | | | | | + | | |

# REPORT on the NUDIBRANCHIATA of the L. M. B. C. DISTRICT.

By W. A. Herdman, D.Sc., F.L.S.,
Professor of Natural History in University College, Liverpool.

This region of the Irish sea has an abundant Nudibranch fauna, and one spot in the neighbourhood of Liverpool, namely, Hilbre Island, is justly celebrated as being the original locality for *Antiopa hyalina*, and some other rare forms, and also on account of the number of other species found on its shores.

Mr. Byerley, in 1855, gave a list of twenty-two species of Nudibranchs, illustrated by a coloured figure of *Antiopa hyalina*. This list included several very rare forms which had been first discovered by himself and by Mr. Price, and had been described by Messrs. Alder and Hancock, in their Ray Society Monograph.*

A few years later (1860), Dr. Collingwood published lists of the Nudibranchiate Mollusca of the Mersey and the Dee in the *Annals and Magazine of Natural History*.† Dr. Collingwood recorded twenty-eight species.

I am indebted to Mr. J. Price, of Chester, for having very kindly placed at my disposal his MS. notes on the Fauna of the Estuary of the Mersey, dating back as far as 1840; some of the records of species given below are on Mr. Price's authority.

* "British Nudibranchiate Mollusca," 1844–1855.
† See this volume, p. 25.—Ed.

## NUDIBRANCHIATA.

### Sub-order.—ACANTHOBRANCHIATA.

### Family.—DORIDIDÆ.

*Archidoris* * *tuberculata*, Cuvier.

This species is not uncommon in this neighbourhood. Byerley records it from Hilbre Island, Caldy Blacks, and the rocks at New Brighton. It is very variable in size and colouring. Alder and Hancock state that a specimen five inches in length was obtained by Mr. Price on the coast of North Wales in 1852. It has been taken by the Committee frequently at Hilbre Island, and other places in the neighbourhood.

It was found frequently on the rocks at Port Erin, Isle of Man, during August.

*Archidoris johnstoni*, Alder and Hancock.

One specimen was found by Mr. Byerley, at Hilbre Island, in 1851. Mersey and Dee, once or twice (Collingwood).

*Archidoris flammea*, Alder and Hancock.

This rare species was dredged by Prof. Ed. Forbes off Ballaugh, Isle of Man, from a depth of twenty-five fathoms.

*Lamellidoris bilamellata*, Linnæus.

Recorded by Byerley and by Price from New Brighton, Hilbre Island, &c. Byerley states that the large brown variety is sometimes plentiful on the rocks at Hilbre, while "a smaller and lighter coloured variety is abundant on the dock wall at Woodside, and along the Cheshire side of the Mersey." Mr. Price informs me that this species used to be of particularly large size at Tranmere. It spawns in March, and disappears from the shore at the end of May.

* Bergh, in his *Report upon the "Challenger" Nudibranchiata*, replaces, for reasons there explained (*loc. cit.*, p. 84), the Linnæan *Doris* by the new generic title *Archidoris*, which I have adopted.

*Lamellidoris depressa*, Alder and Hancock.

Mr. Byerley states that he once met with a specimen of this small species at Hilbre Island.

*Lamellidoris proxima*, Alder and Hancock.

This species was first discovered on the Birkenhead shore by Mr. Price. He informs me that he found it abundant and spawning, on February 21st, 1845. Mr. Byerley records that it was extremely common on the shore between Egremont and New Brighton in August, 1855. He has also taken it freely at Hilbre Island, and had met with white and yellow varieties.

*Acanthodoris pilosa*, Müller.

This species is not uncommon; Byerley records it from "Hilbre Island, Caldy Blacks, and other rocky places." He also mentions having obtained a deep purplish-black variety at Hilbre; this is the *Doris nigricans* of Fleming, it has been taken in the Firth of Forth.*

The ordinary light-coloured form of *Acanthodoris pilosa* has been found several times lately at Hilbre Island by the Committee.

*Acanthodoris quadrangulata*, Alder and Hancock.

*Doris subquadrata*, Alder and Han.

The second specimen known of this rare species was found by Mr. Byerley and Mr. Webster at Caldy Blacks, and was examined and named by Mr. Alder.

Family.—POLYCERIDÆ.

*Goniodoris nodosa*, Montagu.

Isle of Man (Forbes).

Penmaen-rhos and Llandrillo Bay, North Wales (Price.)

* See Leslie and Herdman, *The Invertebrate Fauna of the Firth of Forth*, Edinburgh, 1881, p. 103.

*Goniodoris castanea*, Alder and Hancock.

A fine specimen of this rare species, 1⅛ inches in length and of rather a dark colour, was dredged in August, 1885, between Port St. Mary and Spanish Head, Isle of Man, from a depth of twenty fathoms; bottom, Nullipore. I dredged a similar specimen a few years ago in deep water off Holy Isle, Lamlash Bay, Arran.

*Triopa claviger*, Müller.

This species has been dredged by Forbes off the Isle of Man.

*Polycera lessoni*, d'Orbigny.

Mr. Byerley dredged one specimen of this species on the north coast of Wirral in 1852.

*Polycera ocellata*, Alder and Hancock.

Frequently taken at Hilbre, Egremont, and elsewhere (Byerley).

*Polycera quadrilineata*, Müller.

Found at the Isle of Man (Forbes).

*Ancula cristata*, Alder.

This species is common in this neighbourhood, especially at Hilbre Island. It has been recorded by Price and by Byerley from various points on the coast. It was taken at Hilbre Island on May 17th, June 18th, and July 11th; and was dredged in Hilbre Swash on May 9th.

Specimens fully one inch in length have been found at Hilbre.

Sub-order.—POLYBRANCHIATA.

Family.—TRITONIIDÆ.

*Tritonia hombergi*, Cuvier.

Forbes dredged large specimens of this species from twenty-five fathoms off the north coast of the Isle of Man. He found two varieties, of which the yellow one was larger than the purple, and attained a size of six inches.

One specimen of this species was found at Hilbre (S. Archer). Byerley records it as having been also found upon the western shore of the Mersey, near the entrance of the river. Mersey and Dee, occasional (Collingwood).

*Tritonia plebeia*, Johnston.

Dredged north of Wirral (Byerley). Mersey and Dee, occasional (Collingwood).

This species was found on Hilbre Island at low-water mark on May 17th, 1885; and was dredged in Hilbre Swash on May 9th.

Family.—DENDRONOTIDÆ.

*Dendronotus arborescens*, Müller.

This large and very beautiful species is usually one of the commonest Nudibranchs at Hilbre Island. In mid-winter I have found it in great abundance creeping over the stones and seaweeds close to low-water mark. In some of the L. M. B. C. expeditions to Hilbre, in early summer, on the other hand, very few specimens were found; but later on, in July, *Dendronotus* was again abundant. Mr. Price and Mr. Byerley record it from Hilbre, New Brighton, and Woodside Slip, but say that it is (1855) by no means so abundant as in former years. I am inclined to think that these variations in the abundance of this species at Hilbre are due to a habit of migrating periodically from the shore into deep water. It is intended in future expeditions of the L. M. B. C. to Hilbre Island to make careful observations upon the relative abundance of this and other species.

Recorded from the Isle of Man by Forbes.

This species was dredged during the cruise of the "Hyæna" off the Great Ormes Head, from a depth of seven to eight fathoms, and was obtained during August between Port St. Mary and Spanish Head, Isle of Man, from a depth of twenty fathoms.

## Family.—Melibidæ.

*Doto coronata*, Gmelin.

Taken at Woodside (Price). Mersey and Dee, very common (Collingwood). Isle of Man (Forbes).

This species is not uncommon now at Hilbre Island, although at the time when Byerley's *Fauna* was written it had only been found once in the neighbourhood.

It was dredged in August off the south end of the Isle of Man, near Port Erin.

It was obtained during the cruise of the "Hyæna" off the north end of Puffin Island, from a depth of eleven to thirteen fathoms, on May 24th; it was found at Hilbre Island on June 18th, and was dredged in Hilbre Swash on May 9th.

*Doto fragilis*, Forbes.

Forbes first found this species off the Manx coast in deep water, and described and figured it in his *Malacologia Monensis* (1838) under the name of *Melibæa fragilis*.

It was dredged during the cruise of the "Hyæna" off the north end of Puffin Island, from a depth of eleven to thirteen fathoms, on May 24th; and also off Port Erin, and between Port St. Mary and Spanish Head, Isle of Man, during August, from depths of fifteen to twenty-five fathoms.

## Family.—Proctonotidæ.

*Antiopa cristata*, Delle Chiaje.

This species is recorded from the Menai Straits by Mr. Alder; and from the Dee by Dr. Collingwood.

*Antiopa hyalina*, Alder and Hancock.

This rare species was first found in July, 1851, by Mr. Byerley and Mr. Price, junior, who each picked up a single specimen at Hilbre Island. In August, 1854, Mr. Byerley found another fine specimen in the same locality, and sent

it to Mr. Alder for examination and description. The species has since been found at Hilbre Island by Mr. Higgins; and Mr. T. J. Moore informs me that he has also found two specimens there.

It is figured by Byerley in his *Fauna* (p. 46).

## Family.—Eolididæ.

*Eolis papillosa*, Linn.

Recorded by Byerley from Hilbre, Caldy Blacks, New Brighton, &c. The small light-coloured variety formerly described as a distinct species, under the name of *Eolis obtusalis*, by Alder and Hancock, was found by Mr. Byerley at Hilbre and at Egremont. Mr. Price informs me that it used to be found at Woodside slip.

This species has been taken several times during the last year at Hilbre Island.

*Eolis glauca*, Alder and Hancock.

Dredged off Beaumaris, Menai Straits (Alder and Hancock).

*Facelina coronata*, Forbes.

Recorded by Byerley from Hilbre Island, Egremont, &c.; and by Price from Seacombe.

This is a common species in the neighbourhood. Sometimes a large number of specimens may be found creeping over the stones at Hilbre Island. It was collected at Hilbre Island on May 17th, and June 13th, 1885.

*Flabellina drummondi*, Thompson.

Recorded by Byerley as the commonest species of the neighbourhood. Seacombe (Price). Mersey and Dee, very common (Collingwood).

It is frequently found in abundance at Hilbre Island.

Alder and Hancock describe a remarkable variety of this

species from the Menai Straits, opposite Bangor, having the branchial processes of a sage green colour.

*Coryphella lineata*, Lovén.

Isle of Man (Forbes). Dredged from shallow water, Douglas, Isle of Man (Alder).

Two specimens of this species were dredged during August off Port Erin, Isle of Man, from a depth of fifteen fathoms.

*Coryphella gracilis*, Alder and Hancock.

Menai Straits (Alder).

One specimen of this rare species was dredged during the cruise of the "Hyæna" off the north end of Puffin Island, from a depth of eleven to thirteen fathoms, on May 24th.

*Coryphella landsburgi*, Alder and Hancock.

The second specimen known of this rare species was found in 1849, by Mr. Byerley, at Hilbre. Another specimen of probably the same species, but much larger size, was found in the same locality in June, 1858.

*Coryphella rufibranchialis*, Johnst.

Recorded by Dr. Collingwood as being not uncommon in the Mersey and the Dee.

*Cavolina concinna*, Alder and Hancock.

"Mersey; common (the second known locality)" (Collingwood).

*Cavolina olivacea*, Alder and Hancock.

"Dee; once taken" (Collingwood).

*Cavolina amœna*, Alder and Hancock.

One specimen of this small Eolid was dredged off Port Erin, Isle of Man, in August, 1885, from a depth of fifteen fathoms.

*Cavolina aurantiaca*, Alder and Hancock.

Mr. Price, Mr. Byerley, and Dr. Collingwood have found this species occasionally at Hilbre, Woodside, New Brighton, &c.

*Cavolina arenicola*, Forbes.

This species was dredged in 1844 by Prof. Forbes off Anglesey, at the entrance to the Menai Straits, from a depth of ten fathoms, on a weedy bottom.

*Cavolina viridis*, Forbes.

First discovered by Prof. Forbes on *Antennularia*, dredged from deep water off the Manx coast.

*Cuthona nana*, Alder and Hancock.

This species was collected on July 11th, 1885, at Hilbre Island, during one of the expeditions of the L. M. B. C.

*Galvina picta*, Alder and Hancock.

Found occasionally at Hilbre and Egremont (Byerley). Mersey and Dee, not uncommon (Collingwood). Menai Straits (Forbes). Off Red Wharf Bay, May 25th, 1885.

This species was dredged off Port Erin, Isle of Man, in August, from a depth of fifteen fathoms.

*Galvina tricolor*, Forbes.

*Eubranchus tricolor*, Forbes, *Malacologia Monensis*, p. 5.

Off Isle of Man, twenty fathoms, and off Anglesey (Forbes).

This large and beautiful species was first found by Prof. Ed. Forbes in September, 1836, off the Manx coast, at a depth of twenty fathoms, and is described and figured in his *Malacologia Monensis* under the name of *Eubranchus tricolor*. Since then it has been found at various places on the west coast, and is not uncommon in the neighbourhood of Lamlash Bay, Arran.

One large specimen was dredged during August, between

Port St. Mary and Spanish Head, Isle of Man, from a depth of twenty fathoms.

*Tergipes despecta*, Johnston.

Several specimens of this small Eolid were found on June 13th by the L. M. B. C. adhering to Zoophytes at the north end of Hilbre Island, near low-water mark; the small kidney-shaped masses of spawn were abundant. It was found again at Hilbre Island on July 11th.

The species has been recorded from Garth Ferry, Bangor, North Wales, by Alder and Hancock; and from the Mersey by Collingwood.

*Tergipes exigua*, Alder and Hancock.

This species was found along with the preceding one at Garth Ferry, Bangor, North Wales, by Alder and Hancock. It is also recorded by Dr. Collingwood as being rare in the Mersey.

*Embletonia pallida*, Alder and Hancock.

This rare species was discovered amongst seaweed on the shore at Birkenhead in the spring of 1854, and sent for description to Messrs. Alder and Hancock.

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As the Nudibranchs are not included in the distributional tables of the Mollusca on pp. 247 to 266, a table is here appended showing the distribution of the above noted species in the three parts of the L. M. B. C. district in which they have been collected and recorded. The first column includes Hilbre Island; and the second takes in the entrance to the Menai Straits and the coast of Anglesey.

Probably the greater number of species recorded from the Mersey district is mainly due to that region having been so thoroughly investigated by Mr. Price, Mr. Byerley, Dr. Collingwood, and other naturalists of this neighbourhood.

| NUDIBRANCHIATA. | Estuary of the Mersey. | North Wales. | Isle of Man. |
|---|---|---|---|
| *Archidoris tuberculata* .. | × | × | × |
| *A. johnstoni* ... ... | × | | |
| *A. flammea* ... ... | | | × |
| *Lamellidoris bilamellata* ... | × | | |
| *L. depressa* ... ... | × | | |
| *L. proxima* ... ... | × | | |
| *Acanthodoris pilosa* ... ... | × | | |
| *A. quadrangulata* ... | × | | |
| *Goniodoris nodosa* ... ... | | × | × |
| *G. castanea* ... ... | | | × |
| *Triopa claviger* ... ... | | | × |
| *Polycera lessoni* ... ... | × | | |
| *P. ocellata* ... ... | × | | |
| *P. quadrilineata* ... ... | | | × |
| *Ancula cristata* ... ... | × | | × |
| *Tritonia hombergi* .. ... | × | | × |
| *T. plebeia* ... ... | × | | |
| *Dendronotus arborescens* ... | × | × | × |
| *Doto coronata* ... ... | × | × | × |
| *D. fragilis* ... ... | | × | × |
| *Antiopa cristata* ... ... | × | × | |
| *A. hyalina* ... ... | × | | |
| *Eolis papillosa* ... ... | × | | |
| *E. glauca* ... ... | | × | |
| *Facelina coronata* ... ... | × | | |
| *Flabellina drummondi* ... | × | × | |
| *Coryphella lineata* ... ... | | | × |
| *C. gracilis* ... ... | | × | |
| *C. landsburgi* ... ... | × | | |
| *C. rufibranchialis* .. | × | | |
| *Cavolina concinna* ... ... | × | | |
| *C. olivacea* ... ... | × | | |
| *C. aurantiaca* ... ... | × | | |
| *C. amœna* ... ... | | | × |
| *C. viridis* ... ... | | | × |
| *C. arenicola* ... ... | | × | |
| *Cuthona nana* ... ... | × | | |
| *Galvina picta* ... ... | × | × | × |
| *G. tricolor* ... ... | | × | × |
| *Tergipes despecta* ... ... | × | × | |
| *T. exigua* ... ... | | × | |
| *Embletonia pallida* ... ... | × | | |

# NOTES on the CEPHALOPODA Collected by the L. M. B. C. during the Summer of 1885.*

BY W. E. HOYLE, M.A., M.R.C.S., F.R.S.E.,

NATURALIST TO THE "CHALLENGER" EXPEDITION COMMISSION, EDINBURGH.

*Eledone cirrosa* (Lamarck), d'Orbigny.

1776. *Sepia octopodia* (?), Pennant, *Brit. Zool.*, vol. IV., p. 53, pl. xxviii, fig. 44.

1799. *Octopus cirrhosus*, Lmk., *Mem. Soc. Hist. Nat. Paris.* t. i, p. 21, pl. i, fig. 2.

1853. *Eledone cirrhosus*, Forbes and Hanley, *Brit. Moll.*, vol. iv, p. 211, pl. KKK, fig. 4; pl. MMM, fig. 1.

1869. *Eledone cirrosa*, Jeffreys, *Brit. Conch.*, vol. v, p. 146, pl. vii, fig. 2.

Two specimens (both females) were placed in my hands for examination, one labelled "Hilbre Island, low water, 1885," the other "Hyæna, May 24, 1885."

This species is the commonest Octopod of the northern British shores, and, indeed, of those of the north-west of Europe generally. The males are distinguished by having the third or ventro-lateral arm of the right side modified into a spoon-shaped copulatory organ. The males should be carefully looked for in future expeditions, because Steenstrup† has described a peculiar modification of the tips of the other arms, which it is very important should be confirmed, because his specimen was not in good condition. The suckers cease a few millimeters from the extremity, and each is replaced by a pair of minute cirri.

* For the complete record of the Cephalopoda see Report on the Mollusca, p. 245.—ED.

† *K. dansk. Vidensk. Selsk. Skriv.*, Rk. iv, Bd. iv, p. 206, Tav. ii, fig. 6: for translation, see *Ann. Mag. Nat. Hist.*, series 2, vol. xx, p. 102.

This fact would have an important bearing on the question of the identity of this species with the *Eledone aldrovandi* of the Mediterranean, which closely resembles it, but has the tips of the arms like those of *Eledone moschata*.

*Eledone Pennantii* and *Eledone Aldrovandi* of Macgillivray,* found near Aberdeen, are probably both referable to this species, but the latter is rather doubtful; it cannot, however, be referred with more probability to any other.

*Sepiola atlantica*, d'Orbigny.

1839. *Sepiola atlantica*, d'Orb, *Céph. acét.*, p. 235; *Sépioles*, pl. iv, figs. 1–12.

1853. *Sepiola atlantica*, Forbes and Hanley, *British Moll.*, p. 217, pl. MMM, fig. 2.

1869. *Sepiola Rondeleti*, Jeffreys, *Brit. Conch.*, vol. v, p. 136 (*pars*).

Three female specimens, labelled "May 24, 1885."

This species has been confused with *Sepiola Rondeléti*, Leach, by most British naturalists; even by one so eminent as the late Dr. Gwyn Jeffreys. He remarks, that "the male [of *S. Rondeléti*] is *Sepiola atlantica* of d'Orbigny," a statement that is absolutely without foundation, as both sexes of both species are known, and both in the present one bear the numerous rows of suckers, on the tips of the ventral arms, which are characteristic of the species.

All the three specimens submitted to me had been preserved in picric acid, a re-agent which, in future expeditions should be avoided for Cephalopoda.

*Loligo media* (Linné), Thomson.

1767. *Sepia media*, Linn, *Syst. Nat.*, ed. xii, p. 1095.

1799. *Loligo subulata*, Lmk., *Mém. Soc. Hist. Nat. Paris*, t. i, p. 15.

1844. *Loligo media*, Thomson, *Rep. Brit Assoc.*, p. 248.

1849. *Teuthis parva*, Gray, *Brit. Mus. Cat. Moll.*, vol. i, p. 76.

* *Moll. Anim. Scot.*, pp. 31, 32, 1843.

1851. *Loligo marmoræ*, Vér., *Céph. Médit.*, p. 95, pl. xxxvii.

1853. *Loligo marmoræ* and *L. media*, Forbes and Hanley, *Brit. Moll*, vol. iv, p. 228–230, pl. QQQ, figs. 1, 2

1869. *Loligo media*, Jeffreys, *Brit. Conch.*, vol v, p. 132.

Two specimens, labelled "May 25 and 24, 1885," one male, one female.

Of the two specimens examined, one has the caudal extremity produced into a slender tapering process several centimetres long, while in the other it terminates in a point only about one centimetre long; such differences in the form of the body are frequent in this species, and have led previous observers to establish new species based in error on this character. Verany's *Loligo marmoræ*, for example, is only one of the short-bodied individuals, and was recognized by d'Orbigny as a female. It has been suggested that the difference between these two forms is a sexual one, and this is borne out by the two specimens in the present collection, for while the shorter is a female, the longer is a male, and has the ventral arm on the left side modified in the usual way, that is, on the distal half of it the suckers are converted into conical papillæ. Steenstrup,* however, states that he has seen males and females of both long and short forms.

* *Ann. Mag. Nat. Hist.*, ser. 2, vol. xx, p. 87.

# REPORT on the TUNICATA of the L. M. B. C. DISTRICT.

By W. A. Herdman, D.Sc., F.L.S.,
Professor of Natural History in University College, Liverpool.

The great majority of the Tunicata discussed in this Report were obtained off the South end of the Isle of Man during August, 1885. A few species were obtained at Penmaenmawr, and during the cruise of the "Hyæna," and three species were found at Hilbre Island. Very few Tunicata have been previously recorded in this district. Byerley, in his *Fauna*, mentions two species of *Ascidia* as having been found at Hilbre Island; and Forbes, in the *Malacologia Monensis*, records five species of Simple Ascidians from the shores of the Isle of Man. In the *British Mollusca* four species of Compound Ascidians, from the same locality, are added to the list. Thus, the previous records in all amount to eleven species.

The present Report deals with forty-seven species, of which at least two are new to science, while seven have not been previously recorded from British seas. Nineteen of the species are Simple Ascidians, twenty-seven are Compound, and the remaining species is the pelagic *Oikopleura flabellum*. I am convinced that, long as this list is, it is still far from complete. The rich Tunicate Fauna of the Manx seas requires a good deal of further investigation before it can be said to be thoroughly known.

## LARVACEA.

### Family.—Appendiculariidæ.

*Oikopleura flabellum*, J. Müller.

*Appendicularia flagellum*, Huxley, *Phil. Trans.*, 1851, part ii, p. 595.

An *Appendicularia*, which apparently belongs to this species, was very abundant on the surface of the sea near Port Erin, Isle of Man, on certain days in July and August. It was taken in the tow-net on July 30th, August 1st, August 7th, August 18th, August 19th, August 21st, and on August 22nd. All the specimens seem to belong to the one species, and they are all of about the same size.

The British species of the Appendiculariidæ have never been critically examined, and they are probably more abundant than is generally supposed.

In 1845, Forbes and McAndrew found a species of *Appendicularia* in abundance off the north coast of Scotland. It gave a red colour to the surface water, and, from Forbes' figure,* it seems to have been unlike any of the known species; it was a short-bodied form with a cleft at the end of the appendage. Huxley, in 1856, † described specimens of *Appendicularia flabellum* which he had obtained in the Bristol Channel, near Tenby. In 1858, Allman found a species of *Appendicularia* in the Firth of Clyde, and Strethill Wright recorded one from the Firth of Forth.‡ Various species from other seas have been described by Gegenbaur, Moss, and Fol. In 1874, Sanders § described two species, one an *Oikopleura*, and the other a *Fritillaria*, but both apparently new to science, from Torquay harbour.

These are the published records of Appendiculariidæ in British waters. A few years ago Dr. Sorby, F.R.S., sent me a large number of specimens, mostly of the present species, which he had obtained during the cruise of his yacht, "The Glimpse," round the south coast of England; and while dredging during the last few summers on the west coast of

* *British Mollusca*, vol. i, pl. W., fig. 1.

† *Quart. Journ. Micro. Soc.*, vol. iv, p. 181, 1856.

‡ *Proc. R. S. Edin.*, vol. iv, p. 128,

§ *Monthly Microsc. Journ.* vol. xi, p. 141.

Scotland, I have taken Appendiculariidæ in the tow-net at Lamlash Bay, Arran, in Loch Fyne, and in the Sound of Mull. Mr. Thomas Bolton, of Birmingham, informs me that he has found *Appendicularia* (species undetermined) at Brodick Bay, Arran, off the pier at Llandudno, at Tenby, and at Falmouth. Dr. John Lowe writes to me that he found *Appendicularia flabellum* in considerable quantity on various occasions, from 1867 to 1873, in the river Ouse at King's Lynn; Prof. Haddon noticed the genus in Berehaven, on the S. W. coast of Ireland, in the summer of 1885; Mr. W. H. Shrubsole has frequently taken it with the tow-net at Sheerness in 1885, 1884, and some previous summers; and Prof. McIntosh, in answer to a query I sent to *Nature*, states that *Appendicularia* is prevalent in summer and autumn along the east coast of Scotland.

## ASCIDIACEA.

### ASCIDIÆ COMPOSITÆ.

#### Family.—Botryllidæ.

*Polycyclus savignyi*, Herdman.

*Botryllus polycyclus*, Savigny, *Mém.*, p. 202, 1816.

A large species of *Polycyclus*, which appears to be not uncommon in deep water off the west coast, is, I believe, identical with Savigny's *Botryllus polycyclus*. It is not the same species as *Polycyclus renierii* (= *Botryllus stellatus*, Renier), which has been described by Lamarck, and since by Grube, Della Valle, and von Drasche.* Whether this is the *Botryllus polycyclus*, Sav. (?) of Alder,† is doubtful. He describes it as living under stones within tide marks. My specimens have always been dredged from depths of from five to twenty fathoms.

* See, *Die Synascidien der Bucht von Rovigno*, p. 13, 1883.

† *Cat. Mar. Moll., &c., Trans. Tyneside N.F.C.*, vol. i, p. 111.

This species is undoubtedly a *Polycyclus*.* It forms rounded masses up to five cm. or more in length and breadth, and 1·5 cm. in thickness. These colonies are never incrusting, and are usually very slightly attached to a fragment of seaweed or a Zoophyte. Half a dozen specimens were dredged off Bradda Head, near Port Erin, on July 30th, 1885, from a depth of twenty fathoms, and one colony was dredged off the Halfway Rock, near Port Erin, in August, from a depth of fifteen fathoms. This last specimen had the test of a dark blue colour with brown Ascidiozooids.

Several small colonies attached to *Hydrallmania falcata* and other Zoophytes, which were dredged during the cruise of the "Hyæna," on May 24th, 1885, off Bangor, from a depth of ten fathoms, may possibly belong to this species or to a closely allied one. They are certainly referable to the genus *Polycyclus*, but although the colonies are small, the Ascidiozooids are larger and more conspicuous than in the Manx specimens. The internal structure seems, however, to be much the same in the two cases.

In all the colonies the system of vessels in the test is very well developed, and the terminal bulbs form conspicuous red or brown dots which are clearly visible from the outside. The tentacles are sixteen in number, eight large and eight very small. The pigment masses which are placed in the mantle over the median lateral tentacles in *Polycyclus jeffreysi* are also visible in the Manx specimens. Some of the smallest of the "Hyæna" specimens show pallial budding in various stages, but no stolonial buds were noticed.

*Botryllus morio*, Giard (?)

I refer to this species, with a certain amount of doubt, a small colony of *Botryllus*, which was found adhering to

* For the characters of the genus, see Herdman, "Challenger" Report, "Tunicata," part ii, 1886.

Algæ in a shore-pool at Port Erin, Isle of Man, on August 25th. Unfortunately, Giard, in most of the new species which he formed, described only the external appearance, and especially the colours; consequently it is almost impossible to identify spirit specimens from his descriptions; and even in the case of living specimens, on account of the great amount of individual variation found in the Botryllidæ it is very desirable to have some anatomical characters to supplement the surface markings.

This species is in external appearance more like *Botryllus morio*, or some of the many allied varieties and species* than any other described form. When living, the colony as a whole was of a dark colour. The test was dull grey, marked with opaque grey or white dots. The Ascidiozooids are not large; there are from six to twelve in a system, and the systems are not crowded. The colour of the Ascidiozooid was darkish brown, with a lighter streak along the centre, and with distinct white tentacles in the branchial siphon, of which three were more conspicuous than the fourth. The margins of the common cloacal apertures are marked with opaque white lines.

*Botryllus smaragdus*, Milne-Edwards. (Pl. VI, fig. 7.)

One large and several smaller specimens of this species were found on the shore near Port Erin, during August. Giard† states that the specimens of this species which he examined, had the tentacles yellow, and the ends of the vessels in the test also yellow. In the manx specimens (when alive), the tentacles were white, while the vessels had their terminal bulbs (which were particularly large and conspicuous), of a dark green colour. This species is very variable in its colouring, and several tints of green may even be found in the one colony.

* See Giard, *Archives de Zool. expér.*, t. 1, p. 629, 1872.

† *Loc. cit.*, p. 626.

The region at the base of the branchial siphon in this species is shown in Plate VI, fig. 7. The tentacles are of three lengths. There are two of the largest size which are placed laterally, and have masses of pigment cells of a greenish yellow colour at their bases. Those of the next size are also two in number, and are dorsal and ventral in position, while the smallest size consists of a series of four tentacles alternating with the others, but springing from a line placed nearer to the branchial aperture. The dorsal tubercle is small, and is nearly circular in outline (Pl. VI, fig. 7, *d. t.*); there is no distinct peri-tubercular area. At the ventral edge the peripharyngeal band turns very distinctly posteriorly, to become continuous with the edges of the endostyle (see Pl. VI, fig. 7, *en.*)

*Botryllus violaceus*, Milne-Edwards.

This striking species is fairly common around the south end of the Isle of Man, and it seems to extend further up the shore than any other species of *Botryllus*, or than any other Compound Ascidians, except perhaps some of the species of *Leptoclinum*.

*Botryllus violaceus* is usually found attached to the under surfaces of large flat stones in tidal pools, and it often forms colonies of very considerable size, several inches in diameter. The colonies are always very thin, and difficult to detach without tearing. The species is very variable in colouring, and Giard * has formed a number of varieties based upon the particular tint of blue and the breadth of the characteristic white lines. Of these the Manx specimens seem to belong to the three varieties, *cyanus*, *scala*, and *nigricans*, and most of them are certainly var. *scala*, which is, I believe, the commonest British form.

This species has not previously been recorded from the locality. I have found it before at Lamlash Bay, in the

* *Arch. de Zool. Expér.*, t. 1, p. 621.

Clyde district, and in the Sound of Mull. The Isle of Man specimens were found on the shore at Port Erin, and at Bay-ny-Carrickey, near Port St. Mary.

*Botryllus schlosseri*, Pallas.

This species is not uncommon on the shores of the south end of the Isle of Man. It was taken at Port Erin and at Bay-ny-Carrickey, attached to *Fucus*, and under stones near low water mark, and in tidal pools.

*Botryllus gemmeus*, Savigny.

Recorded by Forbes (*Brit. Moll.*) as having been found by himself at Ballaugh, Isle of Man, adhering to stones at low water.

*Botryllus pruinosus*, Giard (?).

A few colonies obtained under stones, near low water mark, at Port Erin and Bay-ny-Carrickey, may possibly belong to this species; but, in the absence of any anatomical characters in Giard's description, it is impossible to settle the question definitely.

*Botrylloides rubrum*, Milne-Edwards.

This species is common around the south end of the Isle of Man. It was found in deep water by dredging off Spanish Head, attached to Algæ and Zoophytes, and also on the shore, attached to Algæ, etc., at Port Erin, and at Bay-ny-Carrickey. It was also collected at Penmaenmawr, by Mr. Thompson, in July.

The Manx specimens show great variation in colour and in the size, both of the systems and also of the Ascidiozooids. The colour most commonly seen is a brilliant scarlet, but yellow tints are also found.

*Botrylloides albicans*, Milne-Edwards.

A pure white *Botrylloides*, several specimens of which were found at the Isle of Man, appears to belong to

this species. It generally forms small rounded colonies of one or two systems each, which are attached to Algæ and Zoophytes; but one colony of larger size, several centimetres in diameter, and composed of half a dozen systems, was found incrusting the lower surface of a stone in a shore-pool at Port Erin. The other colonies of this species were obtained at Bay-ny-Carrickey, near Port St. Mary, at low tide.

*Botrylloides*, sp. (?)

A beautiful white *Botrylloides*, one colony of which was obtained at Port Erin incrusting a specimen of *Hydrallmania falcata*, may either be an abnormal specimen of *Botrylloides albicans*, or may possibly be new to science. The systems in this specimen are so ramified and involved that the Ascidiozooids seem to be scattered quite irregularly through the clear and transparent investing mass.

*Botrylloides leachii*, Savigny (?)

A small purplish species of *Botrylloides*, which was found several times in the neighbourhood of Port Erin, Isle of Man, may possibly belong to this species. The test is clear and transparent, with yellowish vessels; while the Ascidiozooids are of a pale purple tint, and are small and numerous. The specimens were attached to Algæ, near low water mark.

Family.—DISTOMIDÆ.

*Distoma rubrum*, Savigny (?).

A species of *Distoma* forming large rounded colonies is not uncommon at the south end of the Isle of Man attached to *Laminaria*, *Fucus*, and other Algæ, and occasionally to stones near low water mark. It is not so brilliantly coloured as the specimen figured by Savigny,* and in this respect agrees with colonies collected by Mr. W. Thompson in Belfast Bay.† The Manx specimens have the test of a

* *Mémoires*, part ii, pl. iii, fig. 1.

† See Forbes and Hanley, *Brit. Moll.*, v. i, p. 18.

greyish colour, while the Ascidiozooids are red, with whitish markings on the anterior end; the systems are very distinct.

This species was found in shore pools at Port Erin, on *Laminaria* cast ashore near Spanish Head, and at low water mark at Bay-ny-Carrickey. It has not been recorded from the neighbourhood before.

*Distoma vitreum*, Alder (?).

Two small specimens of a *Distoma*, which were collected in a shore pool at Port Erin, either belong to this species or to one which is undescribed. They are of a grey colour, and semi-transparent, but the surface is somewhat incrusted with minute sand-grains. In other characters they agree with Alder's short description.*

A colony dredged at Port Erin, attached to the inside of a shell, may also possibly belong to this species. It forms several recumbent ovate masses united by a stolon. It is of a pale grey colour, with a good deal of opaque white pigmentation. The Ascidiozooids are small, and, from their structure, evidently belong to the genus *Distoma*.

*Distoma* sp. (?).

Some specimens of a *Distoma* which were dredged near Port Erin, Isle of Man, from a depth of twenty fathoms, are unlike any species with which I am acquainted, and may possibly be new to science. They form small rounded or pyriform masses, of a clear transparent grey colour, and somewhat incrusted with sand. The body of the Ascidiozooid is short, the alimentary canal projecting very little beyond the branchial sac. In other respects the structure agrees with that of the genus *Distoma*. A more detailed examination of fresh specimens will be necessary before it can be definitely settled whether this is a new species or not.

* *Ann. and Mag. N. H.*, v. xi, 1863.

## Family.—POLYCLINIDÆ.

*Aplidium fallax*, Johnston (?).

A specimen apparently belonging to this species was found by Forbes at the Isle of Man, and figured in the *British Mollusca* (vol. i, pl. A, fig. 1).

*Parascidia forbesii*, Alder.

*Sidnyum turbinatum*, Sav., Forbes, *Brit. Moll.*, v. i, p. 14.

Forbes recorded, in the *British Mollusca*, Savigny's species *Sidnyum turbinatum* from the north shore of the Isle of Man, but in the description mentioned that the Ascidiozooids had 8-lobed branchial apertures. This point showed that Forbes' specimen could not be referred to the genus *Sidnyum*, and therefore Alder very properly transferred it to *Parascidia*, and gave it the specific name, *forbesii*. It has apparently not been found since.

*Morchellium argus*, Milne-Edwards.

*Amaroucium argus*, Milne-Edwards, "Observations," etc., p. 291.

This species was first described as an *Amaroucium* by Milne-Edwards, in 1842, and was afterwards placed in a distinct genus by Giard, on account of the areolated or irregularly thickened condition of the stomach wall.

It is common around the south coast of the Isle of Man, in deep water. It was dredged during August, 1885, off the Halfway Rock, and Bay Fine, near Port Erin, and off Spanish Head, near Port St. Mary, from depths of fifteen to twenty-five fathoms. The specimens obtained showed a good deal of variation in colour. Some were pale greyish yellow, others orange, and others bright red, and all intermediate conditions were found. Many of the larger colonies were of considerable size, and had long peduncles. In some cases the peduncle was entirely covered with an incrusting layer of sand and shell fragments.

*Morchellioides alderi*, n. sp. (Pl. VI, figs. 1–4).

*External Appearance.* The colony is elongated, and is rudely cylindrical in shape. It is attached by the lower part, and the upper end is rounded. The colour is a light semi-transparent grey, sometimes tinged with yellow or pink. The surface is smooth and glistening. The length of the colony is about 1·5 cm., and the greatest breadth about 1 cm.

*The Ascidiozooids* are conspicuous externally. They are elongated antero-posteriorly, and are not distinctly divided into regions. They are closely placed, and there is no apparent arrangement in systems.

*The Test* is soft and gelatinous. It is of a light grey colour, and is transparent. The small test cells are very abundant, and present the usual variety in shape.

*The Mantle* is delicate. The chief muscle bands run longitudinally; they are very distinctly seen on the post-abdomen. The branchial aperture is eight-lobed, and there is a long atrial languet.

*The Branchial Sac* is very long. The transverse vessels are numerous, and all of the same size. The stigmata are of moderate size, and are arranged with great regularity.

*The Alimentary Canal* forms rather a short loop. The stomach is large, and its wall is areolated.

This new species is formed for some small colonies (see Pl. VI, figs. 1, 2) of a clear transparent, or in some cases, slightly yellowish Compound Ascidian, which were found in some of the deeper shore pools near Port Erin, and which, on examination, turned out to belong to the genus *Morchellioides*. This group was formed * for some of the new "Challenger" species, and it is characterised by having an eight-lobed branchial aperture, and an areolated stomach, while the post-abdomen is not pedunculated. These characters are all found in the present species (see Pl. VI, fig. 3),

* Report on "Challenger" Tunicata, part ii, p. 176, 1886.

which has probably, if observed at all, been confused with *Amaroucium proliferum*, a species which it closely resembles in external appearance.

The colonies of *Morchellioides alderi* are sometimes ovate or pyriform, with short stout peduncles (Pl. VI, fig. 2), in other cases they are nearly cylindrical. The thorax of the Ascidiozooid is long (Pl. VI, fig. 3), the abdomen is short, and the post-abdomen is very long and slender, it is not separated from the abdomen by any marked constriction. The eight lobes surrounding the branchial aperture are long and pointed (Pl. VI, fig. 3, *br.*). The atrial aperture is placed on the dorsal edge some way back from the anterior end. It is a large rounded opening with a long narrow atrial languet placed upon its anterior margin. There are a large number of rows of stigmata in the branchial sac. The ciliated cells are distinct. The endostyle undulates from side to side in its course (Pl. VI, fig. 3, *en.*).

The œsophagus leads backwards from the posterior end of the branchial sac to the large globular areolated stomach (Pl. VI, fig. 3). The intestine, after running for a short distance posteriorly from the stomach, turns dorsally and then anteriorly to become the rectum, which runs forwards along the dorsal edge of the abdomen and thorax. The post-abdomen is very long and narrow (Pl. VI, fig. 3, *p. ab.*). All the Ascidiozooids in the colonies examined had the male reproductive organs developed, but none showed ova. The vas deferens is long and conspicuous. Its course is somewhat convoluted. Well developed tailed larvæ were found in some of the specimens. They had the single pigmented sense organ placed far back in the body.

This species may possibly be the one briefly described under the name of "*Sidnyum turbinatum*, Sav. ?" by Alder, in 1848.* It is certainly not a *Sidnyum*, and so far as I

* *Cat. Mar. Mollusca, &c.*, p. 109.

know Alder did not afterwards re-describe it. Whether it is our species is difficult to say, as Alder's brief description is confined to the external appearance. I have named this Manx *Morchellioides* after Mr. Alder.

*Amaroucium proliferum*, Milne-Edwards.

A few small colonies of this species were obtained at low water on the shore at Bay-'ny-Carrickey, near Port St. Mary, but it is not nearly so common a species here as it is further north, in the Clyde district.

*Amaroucium*, sp. (?).

A large colony of an *Amaroucium*, differing from all the known British species, was obtained attached to the "roots" of *Laminaria* from Spanish Head, near Port St. Mary, Isle of Man. It forms an incrusting mass of moderate thickness, and was of a rose colour when living. The test is grey and semi-transparent, and the Ascidiozooids are large, and irregularly scattered. The branchial aperture is six-lobed, and there is a long atrial languet. The branchial sac is large and well developed. The tentacles are of at least two sizes, placed alternately. The stomach is folded longitudinally. I hesitate to describe this form as a new species, as it may possibly be identical with one of the species of *Amaroucium* described by von Drasche from the Adriatic.

## Family.—Didemnidæ.

*Leptoclinum durum*, Milne-Edwards.

*Leptoclinum aureum*, M.-Edw., Forbes, *Brit. Moll.*, v. i, p. 17

Several small colonies of this species, which is readily distinguished by its yellow colour, were found attached to the "roots" of *Laminaria*, from near Port St. Mary and Spanish Head, Isle of Man.

*Leptoclinum maculosum*, Milne-Edwards.

This species is common, chiefly attached to the "roots"

Clavelinidæ as a whole, are nearer to Simple than to Compound Ascidians.

Two members of this family have been found in the district.

*Clavelina lepadiformis*, O. F. Müller.

Several colonies of this species were obtained at Hilbre Island, on July 11th, 1885, attached to the under surface of a large stone, just beyond low-water mark. It had not been previously found in this locality.

Forbes recorded it in the *Malacologia Monensis* as being rare at the Isle of Man. Off the south end of the Island, however, it is abundant. It was brought up constantly in the dredge, off the Halfway Rock, and Bay Fine, near Port Erin, and off Spanish Head and Port St. Mary, from depths of ten to twenty-five fathoms. The Ascidiozooids were large and well-formed, the colonies in many cases being very fine. They were generally attached to stones and dead shells.

Several varieties occurred amongst the specimens dredged off Port Erin. The form with two distinct yellow bands around the anterior end of the thorax (Giards' variety *bicincta*), was found. The pigmented bands on the thorax differed greatly in colour. In some specimens they were white (Giards' sub-variety *rissoana* = *Clavelina rissoana* of Milne Edwards ?); in others, pale lemon yellow (the typical form); in others, golden (Giards' sub-variety *auronitens*); and in some, of a rich cinnamon tint. This last form has apparently not been previously noticed; it might be called variety *cinnamomea*. Some specimens have these bands much wider and more distinct than others.

Most of the colonies dredged in August between Port Erin and the Calf were budding profusely, the young buds showing as opaque white knobs of various sizes, upon the transparent creeping stolons. These stolons were in many cases very long and very abundant, and the small gravel

which forms the bottom in some places off Bay Fine, was bound together, to form an irregularly rounded mass, to which the colony adhered by the stolons.

In size, the Ascidiozooids varied from a few millimetres up to 2·5 cm. antero-posteriorly.

*Perophora listeri*, Wiegmann.

This interesting form was first found on the English coast in 1834, by Lister,* and has since been minutely examined by Giard † upon the coast of Brittany. Some colonies of *Perophora listeri* were dredged during August, 1885, off Spanish Head, near Port St. Mary, from a depth of twenty fathoms. They are attached to Algæ and Zoophytes. This species was dredged by McAndrew and Forbes on the coast of Anglesea, in 1843, but, so far as I am aware, it has not been found in the neighbourhood since.

The branchial sac of this species possesses the peculiarity of having papillæ upon the transverse vessels, like those of *Tylobranchion speciosum.* ‡ I am inclined to regard these papillæ as being rudimentary connecting ducts corresponding to those which bear the internal longitudinal bars in most of the Simple Ascidians.

## Family.—ASCIDIIDÆ.

*Ciona intestinalis*, Linn.

*Ascidia intestinalis*, Forbes and Hanley, *Brit. Moll.*, v. i, p. 31.

A few specimens of this widely distributed species were dredged off Port St. Mary, and off Port Erin, Isle of Man, from depths of ten to twenty fathoms. A single specimen was found by some members of the L. M. B. C. attached to the under surface of a stone at the north end of Hilbre Island, near low water mark. The species had not been

* *Phil. Trans.*, 1834, part ii, p. 365.
† *Arch. de Zool. Expér.*, t. i, p. 615.
‡ See "Challenger" Report, part ii, p. 157.

previously recorded from the neighbourhood of Liverpool; but Forbes mentions having found it rarely on the Laxey Bank, Isle of Man. It is a very common species further north, on the west coast, in the Clyde district.

*Ascidia mentula*, O. F. Müller.

Forbes (*Malacologia Monensis*, p. 58) records this large species as being found off the north coast of the Isle of Man.

*Ascidia virginea*, O. F. Müller.

This common species is the *Ascidia sordida* of Alder and Hancock, and other British authors.* It is recorded by Byerley under that name, as having been found occasionally at Hilbre and dredged in the neighbourhood rarely; and it has been dredged by Edward Forbes off the Manx coast, from a depth of twenty fathoms.

Two large specimens were obtained during the cruise of the "Hyæna," on May 24th, in the Menai Straits opposite Bangor, depth ten fathoms. They are attached to a dead shell, and have rather thin and flaccid tests, giving them somewhat the appearance of *Ciona intestinalis* in the retracted condition.

One of the specimens is noteworthy on account of one of its long slender tentacles being bifurcated at the end. In most other respects, the specimens are normal. The dorsal lamina, however, is rather more distinctly toothed upon the free margin than is usual in the species.

Two smaller specimens (9 mm. and 12 mm. respectively), with more of the ordinary appearance and strength of test, were dredged along with those above described. They are young animals. The larger of them had a specimen of *Modiolaria marmorata*, 3 mm. in length, imbedded in its test on the right side of the body.

* For the synonomy of the species, see Herdman, "Notes on British Tunicata," *Journ. Linn. Soc., Zool.*, vol. xv, p. 279.

A few small specimens of the species were also obtained off Port Erin and Port St. Mary, Isle of Man, from depths of ten to twenty fathoms. One of these, about 1·5 cm. in length, had a *Modiolaria*, fully 5 mm. in length, living in its branchial sac.

*Ascidia scabra*, O. F. Müller.

Two specimens of this species, one of them rather large, were dredged by Mr. Thompson, off Penmaenmawr, in July, 1885; and several specimens were obtained off Port Erin, Isle of Man, in August. The larger specimen from Penmaenmawr has several small *Modiolaria* imbedded in its test, and several of the Manx specimens are also infested with this Mollusc.

The branchial sac of this species seems particularly liable to variation.* In some parts of the Penmaenmawr specimens the internal longitudinal bars in place of being parallel to the interstigmatic vessels, are inclined at a considerable angle to them, consequently the stigmata cross the meshes obliquely. There is a considerable amount of opaque white pigmentation in the mantle, especially in the walls of the very long branchial siphon. One of the Manx specimens is most brilliantly marked with opaque white and scarlet.

*Ascidia elliptica*, Alder and Hancock.

This species is recorded by Byerley as having been found at Hilbre three or four times, attached to stones. No description of the species, except Alder and Hancock's account of the external appearance,† has been published, and I have not met with the species at Hilbre. Possibly it is the same as *Ascidia scabra*.

* See Herdman, *Journ. Linn. Soc., Zool.*, vol. xv, pl. xvii, fig. 3.

† *Catalogue of Moll. of Northumb. and Dur., Trans. Tynes. Nat. F. C.*, v. i, p. 107, 1848.

*Ascidia aspersa*, O. F. Müller.

*Ascidia aculeata*, Alder, *Ann. and Mag. N. H.*, v. xi, p. 156, 1863.

Several small specimens of this common west coast species were dredged off Port Erin during August. They are decidedly smaller than the usual specimens from Lamlash and Loch Fyne, and the outer surface of the test is not so distinctly roughened. The tentacles, which are small, rather distantly placed, and of three distinct sizes, and the dorsal tubercle * are good, and, so far as my experience goes, fairly constant characters by which the species may be determined. In some of the specimens the internal longitudinal bars of the branchial sac showed a good deal of variation, being frequently incomplete or wanting for several meshes. This was especially the case in the neighbourhood of the dorsal lamina, and of the endostyle.

*Ascidia plebeia*, Alder. (Pl. VI, fig. 5.)

Several specimens of this species were dredged from a depth of twenty fathoms, off Spanish Head, Isle of Man. It has not been previously recorded from the neighbourhood.

The specimens show considerable variation in the external appearance, one being quite smooth on the surface, nearly transparent, and very much compressed laterally; it is attached by the entire left side to the inner surface of a Lamellibranch shell. Another specimen is only attached slightly by the posterior end of the body, and has the test rough and of a dull green colour; various foreign particles are attached. There is a good deal of variation also in the position and length of the branchial and atrial siphons.

In one of the Manx specimens, the dorsal lamina has long projections from its free edge, opposite the transverse vessels of the branchial sac. It looks much more like a series of languets connected by a slight membrane, than like

* For the shape see Herdman, *Journ. Linn. Soc.*, vol. xv, pl. xvi, fig. 3.

a toothed dorsal lamina (see Pl. VI, fig. 5). The other specimens have the organ in the usual condition.

One of the specimens shows very distinctly the peculiar arrangement of tentacles which I figured in 1880,* and which is rarely seen in the species, viz., the larger tentacles springing from a point distinctly posterior to the line of origin of the smaller series. This specimen has also a good deal of dark brown pigmentation in the prebranchial zone at the anterior extremity of the endostyle, and the greater part of the prebranchial zone is papillated.

*Ascidia depressa*, Alder and Hancock.

Two specimens of this species were found attached to the under surfaces of stones near low water, on the shore at Bay-ny-Carrickey, Isle of Man. One has the body short, while in the other it is elongated antero-posteriorly. The difference is due chiefly to the size of the branchial siphon, which is in the latter case, drawn out to a great length.

I may add to the description of the internal structure of this species published previously,† that the smaller intermediate papillæ upon the internal longitudinal bars of the branchial sac are not invariably present. In the Manx specimens they are seen in some meshes, and not in others.

*Ascidia prunum*, O. F. Müller.

Forbes, in his *Malacologia Monensis*, records this species as being frequent on the Manx shores. As it has not been found since, it is possible that Forbes may have confused it with *Ascidia scabra*, or *Ascidia virginea*.

*Corella parallelogramma*, O. F. Müller.

*Ascidia parallelogramma*, Forbes and Hanley, *Brit. Moll.*, v. i, p. 34.

Two specimens of this most beautiful species were

* *Journ. Linn. Soc., Zool.*, vol. xv, pl. xix, fig. 4.

† Herdman, *Journ. Linn. Soc., Zool.*, vol. xv., p. 287.

dredged off Spanish Head, near Port St. Mary, from a depth of twenty fathoms; and several were obtained off the Halfway Rock, near Port Erin, from the same depth. The largest specimen is 2·5 cm. in length, and nearly 2 cm. dorso-ventrally. Very much larger specimens are found a little further north on the west coast, at Lamlash Bay, Arran.

This species has not been recorded hitherto either from the neighbourhood of Liverpool or from the Isle of Man.

That peculiarly imperfect condition of the internal longitudinal bars of some parts of the branchial sac, which I first described in 1880 * in this species and another, and which has been found since in a number of other Ascidians belonging to various genera, is seen very well in one of the Manx specimens.

Family.—CYNTHIIDÆ.

*Styela grossularia*, Van Beneden.

*Ascidia grossularia*, Van Beneden, *Récherches s. l'Embryogen.*, etc., *des Ascid. Simp.*, p. 61.

This common and widely diffused species was found in abundance during the cruise of the "Hyæna" in the Menai Straits, nearly opposite Bangor, and close to the training ship "Clio," on May 24th, 1885. The depth was ten fathoms, and the bottom muddy. The Ascidians were attached to cinders and dead shells, in some cases in great profusion. The specimens on the shells were mostly small,† and were of the pale depressed blister-like form, but some of those on the cinders were large and of a red colour. Some of the specimens contained many embryos in various stages of development, and completely formed tailed larvæ were present in the peribranchial cavities. This species was also obtained in abundance off Port Erin, off Port St. Mary, and near Spanish Head, at the south end of the Isle of Man,

* "Notes on British Tunicata," *Journ. Linn. Soc., Zool.*, vol. xv., p. 284.

† Some of these were very minute, less than 0·5 mm. in diameter, and were evidently very young.

from depths of ten to twenty-five fathoms. *Styela grossularia* was first described by Van Beneden * from the Belgian coast, but it has since been found in many parts of the British seas. It was obtained from a depth of 363 fathoms in the Faröe Channel, N. W. of Scotland, during the cruise of the "Porcupine," in 1869.† It has not been previously recorded from this neighbourhood.

*Polycarpa rustica*, Linn. (?)

*Cynthia rustica*, Forbes and Hanley, *Brit. Moll.*, v. i, p. 39.
*Styela rustica*, Traustedt, *Oversigt*, &c , *Vid. Medd.*, &c., Kjobnh. 1880, p. 412.

Large numbers of a small red Ascidian were obtained attached to the basal parts of *Laminaria* and other large Algæ, on the shore, and in shallow water near Port St. Mary and Spanish Head, at the south end of the Isle of Man. In all probability they belong to the present species. They agree closely in external appearance with the *Cynthia rustica* of British authors, and in all anatomical details with the descriptions of Kupffer, Traustedt, and others, except in regard to the reproductive organs. The above-mentioned authors both refer to the single tube-like ovaries on each side of the body, while in the Manx specimens the genitalia are in the form of numerous rounded polycarps. The species consequently must belong to the genus *Polycarpa*, and if Kupffer and Traustedt are correct in referring their specimens with elongated ovarian tubes to the *Ascidia rustica* of Linnæus, then my specimens ought to be placed in a distinct species under the genus *Polycarpa*.

*Polycarpa comata*, Alder.

*Cynthia comata*, Alder, *Ann. and Mag. N. H.*, 1863, p. 163.
*Cynthia ampulla*, Forbes and Hanley, *Brit. Moll*, vol. i, p, 40.
*Cynthia comata*, Kupffer, *Jahresbericht*, 1875, p. 217.
*Styela comata*, Traustedt, *Oversigt*, etc., 1880, p. 414.

* *Récherches s. l'Embryog.*, etc., *des Asc. Simp.*
† *Trans. Roy. Soc., Edin.*, vol. xxxii, part ii, p. 223.

One large specimen of this species was dredged off the Halfway Rock, near Port Erin, Isle of Man, from a depth of fifteen fathoms, in August, 1885. It forms an irregular mass, nearly 3 cm. in longest diameter, and the sandy investment is about 8 mm. in thickness in some places.

A smaller specimen from the same locality is probably also referable to this species. Its branchial and atrial siphons are free from sand, and form relatively large clear grey projections. The stigmata in this specimen are relatively larger than in the adult form, but the vessels of the branchial sac have the usual arrangement.

This species has not been previously found in the neighbourhood, unless it is the form recorded by Forbes (*Malacologia Monensis*, p. 57) from the Isle of Man, under the name of *Ascidia* (*Pandocia*) *conchilega*.

*Polycarpa pomaria*, Savigny.

*Cynthia pomaria*, Savigny, *Mém. s. l. Anim. s. Vert.*, 1816, p. 156.

*Cynthia tuberosa*, MacGillivray, *Hist. Moll. Aberdeen*, p. 311, 1843.

*Polycarpa varians*, Heller, *Untersuchung.*, iii Abth, p. 19.

*Styela pomaria*, Traustedt, *Oversigt*, etc., p. 415.

One large specimen of this widely distributed species was dredged off Bay Fine, near Port Erin, Isle of Man, from a depth of twelve fathoms. It occurs on various parts of the English coast, but has not been previously recorded from this neighbourhood.

The Manx specimen has an abnormal dorsal tubercle. This organ is typically, in this species, of cordate or nearly circular outline, with both horns coiled inwards, and the aperture either on the right side* or the anterior end.† In

* See Kupffer, *Jahresber.*, p. 217.

† See Herdman, Report on the "Triton" Tunicata, *Trans. R. S. Edin.*, vol. xxxiii, part i, p. 96.

the present specimen, the tubercle is of large size (1·5 mm. in diameter). The outline is perfectly circular, and the horns have evidently united on the right side so as to form a ring-shaped structure with no aperture.

*Polycarpa monensis*, n. sp. (Pl. V, figs. 1–8).

*External Appearance.*—The shape of the body is transversely ovate, the dorso-ventral diameter being the larger. There is slight lateral compression and the body is not attached. The surface is rough and irregular from the presence of attached stones and other foreign objects. The colour, where the test is visible, is a dull grey. The length of the body (antero-posteriorly) is 1·5 cm.; the breadth (dorso-ventrally) is fully 2 cm.; the thickness (laterally) is 1·2 cm.

*The Test* is thin but firm. It has shell fragments, and small stones attached firmly to its outer surface. There are no adhering processes. The test matrix is clear and transparent. There are no bladder-cells, and the test-cells are small and inconspicuous.

*The Mantle* is thin and has the musculature feeble. It is closely adherent to the inner surface of the test throughout. The sphincters are moderately strong. Over the rest of the mantle the muscle fibres run in all directions, and form a close but delicate network.

*The Branchial Sac* is not very large. Its walls are delicate. There are three or four folds upon each side. Each fold has about five closely placed internal longitudinal bars upon its surface, while there are one or two bars only in each interspace. The transverse vessels are narrow, and all of much the same size. The meshes are square or slightly elongated transversely. Each contains from four to six rather wide stigmata, and is divided transversely by a narrow horizontal membrane. On the right side of the endostyle there are four rows of meshes of which the most ventral is

larger than usual. On the left side of the endostyle there are only three rows before the ventral fold of that side is reached. The stigmata are much wider than the fine longitudinal vessels between them. They are regularly arranged, and have straight sides with rounded ends.

*The Endostyle* is rather narrow and inconspicuous.

*The Tentacles* are exceedingly small. They are of two sizes, placed alternately. There are twelve or fourteen larger and the same number of smaller intermediate ones.

*The Alimentary Canal* is small. The stomach is ellipsoidal, and has slight longitudinal folds. The intestinal loop is narrow.

*The Reproductive Organs* are in the form of polycarps, partly embedded in the mantle and projecting into the peribranchial cavity.

A single specimen of this new species of *Polycarpa* was dredged on August 1st, 1885, off Port Erin, Isle of Man, from a depth of fifteen fathoms. In external appearance (see Pl. V, fig. 1,) it is rather like one of the Molgulidæ, as the test is incrusted externally with pieces of stone and fragments of shells, etc. There are no branched hairs, the incrusting foreign objects being merely attached to the surface of the test or partly embedded in its substance. The apertures are distinctly visible, and by their quadrangular shape show at once that the Ascidian belongs to the Cynthiidæ, not the Molgulidæ.

The pale grey test is rendered stiff by the attached stones; when these are removed it is weak and flexible. The musculature of the mantle (Pl. V, fig. 4), is not divided into separate layers, as it is in many Cynthiidæ, but merely forms a dense reticulum of very delicate muscle fibres. No definite bundles are formed except on the branchial and atrial siphons. The ectoderm is very distinct (Pl. V, figs. 2, 3).

The branchial sac is notable on account of the large size of the stigmata compared with that of the interstigmatic vessels (Pl. V, fig. 7). The narrow horizontal membranes which divide the meshes transversely, in some places interrupt the stigmata (see Pl. V, fig. 8). On the right side of the branchial sac, there are four longitudinal folds, while on the left side three only are present. The internal longitudinal bars are strong (Pl. V, fig. 7, *i.l*). In some places on the folds they are corrugated.

The small size of the tentacles (see Pl. V, fig. 5), is remarkable, and forms one of the most noteworthy characteristics of the species. There are between twenty and thirty altogether. They are placed far apart, and the two sizes alternate with regularity.

The œsophagus is short (Pl. V, fig. 6, *œ*). It runs ventrally and posteriorly to open into the stomach, which has its long axis directed dorso-ventrally. The intestine runs at first ventrally and then turns anteriorly, then dorsally so as to form a narrow loop. After running along the anterior edge of the stomach, it turns forward to become the long straight rectum, which terminates close to the atrial aperture. The anus (Pl. V, fig. 6, *a*) has a white thickened edge. The polycarps are not numerous. They occur on both sides of the body, and are ovate, and of a pale yellow colour. Each polycarp is hermaphrodite.

## Family.—Molgulidæ.

*Molgula occulta*, Kupffer. (Pl. VI, fig. 6.)

A large number of specimens of the genus *Molgula* were dredged during August, off the south end of the Isle of Man, chiefly between Port Erin and the Calf, and off Spanish Head, from depths of ten to twenty fathoms. They differ considerably in external appearance, some being coated with small stones and fragments of Nullipores and shells, while

others have merely a sandy investment; they all, however, seem to belong to the one species, Kupffer's *Molgula occulta*.* This species has been previously found off the coast of Denmark (Kupffer), at Arendal in Norway (Kupffer), on the coast of Greenland (see Traustedt †), in the Adriatic (Heller‡), and at Torbay § on the English coast. I have recently seen some specimens of the same species which were dredged last summer by Professor Haddon in Bantry Bay, on the S. W. coast of Ireland.

The Manx specimens vary in size from 0·5 cm. to 3 cm. in extreme length; they are of the usual more or less ovate shape. In the case of one specimen dredged off Bradda Head, near Port Erin, on August 22nd, from a depth of fifteen fathoms, several large colonies of the Hydroid *Clytia johnstoni* were found to be attached to the branchial and atrial siphons. When the Ascidian retracted, and the siphons disappeared under the surrounding sandy test, the Zoophytes were crowded together, and to a certain extent drawn in with the siphons, but this compulsory retraction did not seem to have affected the healthy development of the Zoophytes in the least. Probably it was more than compensated for by the abundant food supply brought within reach of the zooids by the Ascidian's inhalent and exhalent currents.

The branchial sac in the Isle of Man specimens agrees in all respects with the descriptions given by Kupffer, Heller, and Traustedt; the tentacles, however, appear to be usually six large (A), six of median size (B), and twelve small

* Kupffer, *Jahresberichte der Kommission zur Untersuchung der deutschen Meere in Kiel*, Berlin, 1874, vii, Tunicata, p. 224.

† *Oversigt over de fra Danmark og dets nordlige Bilande kjendte Ascidiæ Simplices*, Kjöbenhavn, 1880, p. 427.

‡ *Untersuch. ü. d. Tunicaten d. Adriat. u. Mittelm.* iii, Abth. Wien, 1877.

§ Sorby and Herdman, *Journ. Linn. Soc. Lond., Zool.*, vol. xvi, p. 533, 1882.

(C), arranged with regularity as follows:—A, C, B, C, A. Kupffer and Traustedt describe their specimens as having twelve large and twelve small tentacles placed alternately.

The dorsal lamina in the Manx specimens is usually a plain membrane; the free edge may be irregular, but it is not actually toothed. The dorsal tubercle is very variable. It is usually cordate in outline, and has the aperture placed laterally, or even posteriorly. In one specimen, one of the horns was observed to give off a short curved branch directed inwards (see Pl. VI, fig. 6).

*Eugyra glutinans*, Möller.

*Cynthia glutinans*, Möller, *Index Moll., Grönland*, p. 21.
*Molgula tubulosa*, Forbes, *Brit. Moll.*, v. i, p. 36.
*Molgula arenosa*, Ald. and Han., *Ann. and Mag. N. H.* 1863, p. 160.
*Eugyra arenosa*, Hancock, *Ann. and Mag. N. H*, 1870, p. 367
*Eugyra glutinans*, Traustedt, *Vid. Medd. f. d. Naturh. For. Kjobnh.*, 1880, p. 428.

This widely diffused species is fairly abundant off the Halfway Rock, between Port Erin and the Calf of Man, and also off Spanish Head, Isle of Man, at depths of ten to twenty fathoms. The specimens vary considerably in size, although most of them are small (1 cm. in diameter). They are covered by a light yellowish sandy investment, containing many fragments of shells. The largest specimen was 2 cm. in greatest length.

This species has been fully described by Kupffer * and by Traustedt. † It has been found on the coast of Denmark, Norway, Holland, France, the Faröes, Greenland, Siberia, and at various localities on the English coast. It has not been previously recorded from the Isle of Man.

* *Jahresbericht.*

† *Oversigt over de fra Danmark, etc., Ascidiæ Simplices, loc. cit.*

## Explanation of the Plates.

### Plate V.

*Polycarpa monensis*, n. sp.

Fig. 1. Specimen of *Polycarpa monensis*, from side, natural size.

Fig. 2. Ectoderm cells seen in profile, magnified 300 diameters.

Fig. 3. Ectoderm cells, surface view, magnified 300 diameters.

Fig. 4. Part of mantle, magnified 50 diameters.

Fig. 5. Tentacles, magnified 50 diameters.

Fig. 6. Alimentary canal, natural size.

Fig. 7. Part of branchial sac, magnified 50 diameters.

Fig. 8. Small portion of branchial sac, magnified 300 diameters.

### Plate VI.

Figs. 1–4. *Morchellioides alderi*, n. sp.

Fig. 5. *Ascidia plebeia*, Alder.

Fig. 6. *Molgula occulta*, Kupffer.

Fig. 7. *Botryllus smaragdus*, M.-Edw.

Fig. 1. Several small colonies of *Morchellioides alderi*, natural size.

Fig. 2. Single larger colony of *Morchellioides alderi*, natural size.

Fig. 3. An ascidiozooid of *Morchellioides alderi*, seen from right side, magnified 50 diameters.

Fig. 4. Small part of the branchial sac of *Morchellioides alderi*, magnified 50 diameters.

Fig. 5. The dorsal tubercle and anterior part of the dorsal lamina of *Ascidia plebeia*, magnified 50 diameters.

Fig. 6. The dorsal tubercle of *Molgula occulta*, an abnormal specimen, magnified 50 diameters.

Fig. 7. The anterior end of an ascidiozooid of *Botryllus smaragdus*, showing the arrangement of the tentacles, &c., magnified 300 diameters.

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*a*, anus; *at*, atrial aperture; *br*, branchial aperture; *br.f*, fold in branchial sac; *en*, endostyle; *e.gr*, epibranchial groove; *d.l*, dorsal lamina; *d.t*, dorsal tubercle; *gl.d*, duct of neural gland; *i*, intestine; *i.l*, internal longitudinal bar; *l*, dorsal languet; *l.v*, fine longitudinal vessel; *m.f*, muscle fibres; *oe*, oesophagus; *pig*, mass of pigment cells; *p.p*, peripharyngeal band; *p.ab*, post-abdomen; *r*, rectum; *sg*, stigmata of branchial sac; *st*, stomach; *sph.* sphincter; *tn*, tentacles; *tr*, transverse vessels.

## PRELIMINARY LIST of the ALGÆ of the L. M. B. C. DISTRICT.

By Alfred Leicester.

The Algæ collected during last summer's expeditions were few, and none of them specially rare. It should be remembered, however, that no particular search was made for Algæ, the primary object of the expeditions being to collect animals. During the coming summer, it is intended to devote some time to a special study of the Algæ of the district, and it is hoped that a detailed report will be ready for the second volume of the Liverpool Marine Biology Committee's series.* In the meantime it is thought desirable to give a list of those species of Algæ which have been already found in the locality. The classification and nomenclature are those of Harvey's "*Phycologia Britannica.*"

### Class.—ALGÆ.

### Sub-class I.—MELANOSPERMEÆ.

#### Order I.—Fucaceæ.

*Halidrys siliquosa.*
*Fucus vesiculosus.*
*Fucus serratus.*
*Fucus nodosus.*

* Mr. F. P. Marrat, who has been working for some years at the seaweeds of the district, will probably also contribute a report upon certain groups of the Algæ.—Ed.

Order II.—SPOROCHNACEÆ.

*Desmarestia aculeata.*
*Desmarestia viridis.*

Order III.—LAMINARIACEÆ.

*Laminaria digitata.*
*Laminaria saccharina.*

Order IV.—DICTYOTACEÆ.

*Dictyota dichotoma.*
*Punctaria latifolia.*

Order VI.—ECTOCARPACEÆ.

*Cladostephus spongiosus.*
*Sphacelaria plumosa.*

Sub-class II.—RHODOSPERMEÆ.

Order VII.—RHODOMELACEÆ.

*Polysiphonia formosa.*
*Polysiphonia fibrillosa.*
*Polysiphonia fastigiata.*
*Polysiphonia byssoides.*
*Dasya coccinea.*

Order IX.—CORALLINACEÆ.

*Corallina officinalis.*

Order X.—DELESSERIACEÆ.

*Plocamium coccineum.*

Order XI.—RHODYMENIACEÆ.

*Rhodymenia palmetta.*

Order XII.—CRYPTONEMIACEÆ.

*Chondrus crispus.*
*Peyssonelia dubyi.*
*Catenella opuntia.*

Order XIII.—Ceramiaceæ.

*Ptilota plumosa.*
*Ceramium rubrum*
*Griffithsia corallina.*
*Callithamnion pedicellatum.*

Sub-class III.—CHLOROSPERMEÆ.

Order XVI.—Ulvaceæ.

*Ulva latissima.*

# FIRST REPORT on the MARINE FAUNA in the Neighbourhood of PENMAENMAWR.

By Isaac C. Thompson, F.R.M.S.

During the month of July, 1885, I spent a few weeks in the neighbourhood of Penmaenmawr examining the Marine Fauna of the district, by dredging and tow-netting from a boat, and also by collecting on the rocks at low water.

The district explored included the Mouth of the Menai Straits, the sea between the Welsh Coast and Puffin Island (seven miles across), and, in the other direction, towards the Great Ormes Head, as well as the region about Colwyn Bay.

The depth in this locality rarely exceeds four fathoms, and the sea bottom is generally clayey and sandy; patches of round stony masses were occasionally met with.

Near to Puffin Island I dredged over a large mussel bed, a very prolific region, yielding quantities of Zoophytes, the abode of innumerable Amphipoda. A similar mussel bed was passed over at the East side of the Little Ormes Head, near Colwyn Bay.

On one rather stormy day early in July the tow-net yielded a large number of specimens of the *Megalopa* stage of crabs; although they were conspicuously absent from all subsequent tow-net gatherings.

During the whole period tow-net work was much impeded by the abundance of some peculiar gelatinous bodies which were distributed throughout the sea. These little bodies were always distinctly visible on holding a bottle of sea water up to the light. They varied in size from $\frac{1}{18}$ to $\frac{1}{10}$ of an inch in diameter, and were spherical or oblong in form,

the translucent bounding membrane appearing under the microscope to be composed of minute particles with spicules imbedded therein. So completely did the gelatinous mass diffuse itself over the tow-net that it was most difficult to find or pick out any small surface animals.

Although the little gelatinous bodies were quite perfect in form when taken in a bottle, the rush of water into the tow-net always broke them up, the result being a mass of debris (apparently vegetable) which clung tenaciously to the muslin of the net. The gelatinous spheres appeared to be most numerous a few feet below the surface, and were distinctly visible on looking down into the water from the boat side. Weather seemed not to affect them, as they were apparently equally prevalent on calm and on rough days; but it was noticed while rowing across from Penmaenmawr to Puffin Island that they were less plentiful about the middle of the entrance to the Menai Straits than nearer each side. Early in June they were noticed in profusion about the mouth of the Dee, on the "Merry Andrew" expedition.

Associated with these gelatinous bodies were always found quantities of *Noctiluca miliaris*, which were congregated about the surface of the collecting jar, while the gelatinous spheres, if not fractured, remained suspended in the water, and the broken debris from the tow-net fell to the bottom.

These spherical gelatinous bodies are probably Algæ, and they have been noticed previously by several observers on different parts of the coast as occurring at times in very great abundance. In *Nature* for July 16th, 1885, Mr. Shrubsole records having noticed them in quantity on the East coast.

In a paper "On the Movements and Food of the Herring,"* Mr. F. Pearcey describes the occurrence in the

* *Proc. Roy. Phys. Soc*, Edin vol. viii, p. 389.

Shetland Seas of vast banks of *Rhizosolenia shrubsolei*, a marine diatom; and he noticed also what was so conspicuous at Penmaenmawr, namely, the almost total absence of the ordinary surface organisms in the tracts of sea infested by the gelatinous Algæ.

A list of the animals obtained by dredging and shore collecting around Penmaenmawr has been drawn up,* but as this is probably far from complete, it has been thought best to keep it for one of the future volumes, so that at least another season's work might be incorporated with it. The following species may, however, be mentioned as being amongst those which have been collected at Penmaenmawr this year:—

*Coryne pusilla, Thaumantias convexa, Aglaophenia pluma, Vermilia triquetra, Thelepus circinatus, Bugula flabellata, Amathia lendigera, Pycnogonum littorale, Botrylloides rubrum, Ascidia virginea, Ascidia scabra, Styela grossularia, Philine aperta,* and *Cypræa europæa.*

* The specimens collected by Mr. Thompson have been distributed to the Authors of the various Reports, and will be found noticed under the groups to which they belong.—Ed.

# NOTES on the MARINE INVERTEBRATE FAUNA of the SOUTHERN END of the ISLE OF MAN.

By W. A. Herdman, D.Sc.,

PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, LIVERPOOL.

The shores of the southern end of the Isle of Man are very varied in their characters, and they support an abundant littoral and shallow-water Fauna. Precipitous cliffs extend nearly all the way from Spanish Head to Port Erin, and from Port Erin to Fleshwick Bay; at Port St. Mary, at Bay-ny-Carrickey, and at Port Erin there are sandy or muddy bays enclosed by rocks; in the neighbourhood of Poyllvaaish and of Port St. Mary, long, flat, shelving reefs run out to sea; while at various places stony shores occur, composed of angular fragments broken off from the cliffs and reefs, and forming perhaps the most prolific of all localities to the marine biologist.

Five weeks in July and August, 1885, were spent in exploring this district, and in making collections, chiefly by dredging, tow-netting, and shore work. My headquarters were at Port Erin,* where there is a long narrow bay facing to the west, and enclosed by rocky sides. Most of the dredging was done at the mouth of this bay, at depths of from ten to fifteen fathoms, the bottom being chiefly gravel. Occasional dredging expeditions were carried out further round the coast—to the north, off Bradda Head,* and a little further; and to the south, off Bay Fine* and the Halfway Rock,* and onwards towards the Calf.* One day was spent in dredging off Port St. Mary and off Spanish Head, and around the eastern side of the Calf.

* See Chart, Pl. XII.

The bottom between the Calf and Port St. Mary, at a depth of fifteen to twenty-five fathoms, is almost entirely composed of living Nullipores, in which, however, a rich and varied Fauna is found. In this locality, the following animals amongst others were obtained:—

*Leucandra nivea, Halisarca dujardinii.*

*Garveia nutans, Tubularia simplex.*

*Adamsia palliata, Corynactis viridis, Polythoa arenacea, Halcampa chrysanthellum.*

*Sarcodictyon catenata.*

*Antedon rosaceus, Cribrella sanguinolenta, Ocnus brunneus.*

*Lineus marinus, Filograna implexa, Hermione hystrix.*

*Cellaria fistulosa, Cribrilina punctata, Membranipora aurita, Umbonula verrucosa, Porella compressa.*

*Pagurus prideauxii, Pagurus cuanensis, Eurynome aspera, Ebalia tumefacta.*

*Lima loscombii, Pecten pusio, Pecten similis, Pecten maximus, Arca tetragona, Pectunculus glycimeris.*

*Phasianella pullus, Trochus zizyphinus, Fissurella græca, Murex erinaceus.*

*Doto fragilis, Dendronotus arborescens, Eolis tricolor, Goniodoris castanea.*

*Clavelina lepadiformis, Perophora listeri, Ciona intestinalis, Ascidia plebeia, Corella parallelogramma, Eugyra glutinans.*

*Morchellium argus, Botrylloides rubrum.*

A large dead valve of *Pecten maximus*, with the following ten species of Polyzoa attached to it, was dredged in this locality:—*Scrupocellaria scruposa, Cellaria fistulosa, Membranipora catenularia, Mucronella peachii, Microporella malusii, Smittia reticulata, Lichenopora hispida, Diastopora patina, Membraniporella nitida, Crisia eburnea.*

In shallower water in this region (between Port St. Mary and the Calf) there are large tracts covered with *Laminaria,*

which are nearly exposed at low water, and from which masses of *Laminaria* are often cast ashore during storms. Attached to the *Laminaria*, especially at the root-like lower ends, are found commonly the following animals :—

*Halisarca dujardinii*, *Leucandra gossei*.

*Harmothoë imbricata*, *Filograna implexa*, *Terebella nebulosa*, *Lumbricus capitatus*.

*Crisia denticulata*, *Crisia cornuta*, *Scrupocellaria scruposa*.

*Verruca strömia*.

*Modiolaria marmorata*, *Saxicava rugosa*, *Anomia ephippium*.

*Helcion pellucidum*, and the variety *læve*.

*Polycarpa rustica*.

*Amaroucium* sp., *Leptoclinum maculosum*, *Diplosoma crystallinum*.

The specimens of *Helcion pellucidum*, var. *læve*, attain a large size. The Compound Ascidians, especially *Leptoclinum maculosum* and *Diplosoma crystallinum*, are very numerous and form large colonies.

The shore at Kitterland,* immediately opposite the Calf, has a number of deep and well-stocked tidal pools. The rocks are covered by great expanses of a white Nullipore, which must protect the shore to a considerable extent against marine erosion. A brilliant scarlet anemone (*Heliactis venusta*) is common in these pools, and along with it is found a sponge (*Amorphina caruncula*) of precisely the same hue. The result of this association is that it becomes sometimes almost impossible to detect the anemone without a close examination.

The other anemones which were noticed on the shores in the neighbourhood of Port Erin were :—*Actinia equina*, *Anemonia sulcata*, *Tealia crassicornis*, vars. *insignis* and *purpurea*, and *Bunodes gemmaceus*.

* See Chart, Pl. XII.

The rocks on the north-western side of Port Erin, extending outwards towards Bradda Head, form a good collecting ground at low water, and many of the tidal pools are well-stocked, and contain some rare species. A couple of large and well-formed specimens of the rare sponge *Isodictya elegans* were obtained from the bottom of a deep pool lined with Nullipore. Many of the pools are almost choked up with *Corallina officinalis*, attached to which may be found *Asterina gibbosa*, and *Amphiura squamata*. The specimens of *Asterina gibbosa* obtained from the pools at Port Erin were all much smaller than those found on the shore at Bay-ny-Carrickey, between Port St. Mary and Castletown.

Port Erin is a very good locality for Compound Ascidians. Magnificent specimens of *Morchellium argus* may be obtained from the deeper tidal pools or hanging from ledges of rock near low water mark. Several species of *Leptoclinum* were found attached to stones lying in the rock pools, and a species of *Diplosoma* was not uncommon in similar situations.

In a very limited area, on the northern side of Fleshwick Bay, there are a number of well-stocked tidal pools. Some of these contain quantities of *Corallina officinalis*, in which may be found *Asterina gibbosa*, *Caprella linearis*, *Pephredo hirsuta* (?), *Amphiura squamata*, *Modiolaria marmorata*, *Sycandra compressa*, and *Chthamalus stellatus*.

Large numbers of a beautiful anemone, with a large brown disk, probably a variety of *Actinoloba dianthus*, are found in these pools, generally attached in crevices of the rock from which it is almost impossible to extract them.

*Patella vulgata*, variety *athletica*, is also very common attached to the rocks at Fleshwick Bay. The specimens are of fair size and of very irregular form. The shell is white and chalky, and the tactile processes of the mantle edge are pure opaque white, and very long.

The only other piece of shore which requires special mention is the flat region, known as Bay-ny-Carrickey, lying between Port St. Mary and Poyllvaaish, near Castletown. Some parts of this beach are wide expanses of sand and sandy mud, with occasional stones and stony pools; while other parts, especially at the Poyllvaaish end, are formed by long low reefs of rock, with many pools and crevices, and overhanging ledges, and well-covered with sea-weed and incrusting animals. *Pleurobranchus membranaceus* is common in this locality, chiefly on the under surfaces of large stones in the pools, along with very fine specimens of *Asterina gibbosa*, much larger than those found at Port Erin. *Trochus zizyphinus* is also common here at low tide.

Compound Ascidians are particularly abundant and large. The following species were collected :—

*Botryllus violaceus*, *Botryllus schlosseri*, *Botryllus pruinosus*, *Botrylloidès rubrum*, *Botrylloides albicans*.

*Distoma rubrum*.

*Amaroucium proliferum*.

*Leptoclinum maculosum*, *Leptoclinum asperum*.

*Diplosoma gelatinosum*.

Some projecting masses of hard clay which occur on one part of this shore, are penetrated in all directions by the burrows of *Pholas crispata*, and those of a small Annelid. Under the stones in the more muddy parts, *Cirratulus borealis* is common; while in the cleaner regions and in the rock-pools, *Nereis pelagica* and *Harmothoë imbricata* are found. Amongst the other species obtained on this shore, were :—*Halisarca dujardinii*, *Leucandra nivea*, *Amorphina panicea*, *Anemonia sulcata*, *Bunodes gemmaceus*, *Polynoë floccosa*, and *Galathea squamifera*.

The most prolific dredging ground in the neighbourhood of Port Erin was found to be in front of Bay Fine and the Halfway rock, between the breakwater and the Calf. Here,

at a short distance from the shore, on a bottom composed of stones and sea-weed and dead shells, the following animals were found to be abundant:—*Antennularia ramosa*, *Plumularia pinnata*, *Antedon rosaceus*, *Echinocyamus pusillus*, *Pectinaria belgica*, *Terebella nebulosa*, *Galathea intermedia*, *Stenorhynchus rostratus*, *Pectunculus glycimeris*, *Velutina lævigata*, *Trochus magus*, *Aplysia punctata*, *Morchellium argus*, *Clavelina lepadiformis*, *Ciona intestinalis*, *Corella parallelogramma*, *Styela grossularia*, *Eugyra glutinans*, and *Molgula occulta*.

The following rarer forms were obtained once or twice in the same locality:—*Halisarca dujardinii*, *Halcampa chrysanthellum*, *Thyone papillosa*, *Cucumaria hyndmanni*, *Hermadion assimile* (on the peristome of *Echinus esculentus*), *Hermione hystrix*, *Carinella lineata*, *Amathia lendigera*, *Crangon sculptus*, *Ebalia cranchii* and *E. tuberosa*, *Inachus dorsettensis*, *Trivia europæa*, *Doto fragilis*, *Eolis picta*, *Eolis amœna*, *Eolis lineata*, *Polycyclus savignii*, *Polycarpa monensis*, n.sp.

The tow-net was used on most days, generally in the neighbourhood of Port Erin. On some few days, when it was too rough to dredge, it was possible to work the tow-net in the more sheltered parts of Port Erin Bay. Whenever the tow-net gathering was at all good, or seemed to shew any peculiar organisms, it was preserved in the following manner for future examination:—The tow-net on being brought on board was turned inside out into a wide-mouthed gallon jar of sea water, in which the organisms could be roughly examined with a pocket lens. A few grains of solid picric acid was then added, so as to kill and precipitate the organisms. A great difference was noticed in the amount of picric acid which the different kinds of animals were able to withstand. All the larvæ, the Medusoid Gonophores, and the Sagittæ die first, while the Crustacea are still quite lively

and active; then, on the addition of more picric acid, the Copepoda stop swimming and fall to the bottom, leaving *Evadne* and any higher Crustaceans, such as Amphipoda and Isopoda, still alive and able to swim about in the picric solution. After all the organisms have been killed and have fallen to the bottom, the superjacent fluid may be poured off so as to reduce its amount, and what remains along with the organisms may then be transferred to a small (1 or 2-oz.) bottle. Then, after settling for a few minutes the greater part of the picric acid solution may be again poured off, and the bottle filled up with alcohol. This process gave fairly good results. The animals were thoroughly preserved, and in most cases had not suffered from excessive or irregular contraction. The previous hardening in picric acid appears to prevent them from being shrivelled by the alcohol. The natural colour, however, is in all cases entirely obliterated as everything is stained opaque yellow by the picric acid.

The following lists have been drawn up* from the tow-net gatherings which were preserved. They shew that, although a slight difference was present in the surface fauna on different days, and at different times, still no definite relation can be established between the time of day, the state of the sea, or the meteorological conditions on the one hand, and the abundance or nature of the surface life on the other:—

I.—July 30th, Port Erin, mid-day.

*Peridinium tripos*, few.

*Thaumantias*, many.

*Pleurobrachia pileus*, few.

* I have to acknowledge the help of Mr. J. A. Clubb, the assistant in the Zoological Laboratory of University College, Liverpool, in making these lists. Mr. Clubb went carefully through the whole of the material, picked out and mounted the species, and identified many of them.—Ed.

Plutei (both Echinid and Ophiurid), many.

Annelid larvæ (*Polynoe ?*), many.

*Sagitta bipunctata.*

Copepoda, numerous (*Dias longiremis*, *Calanus finmarchicus*, and *Oithona spinifrons*).

Nauplei, few.

Zoeæ, and other Crustacean larval forms.

*Evadne nordmanni*, numerous.

*Oikopleura flabellum*, very few.

II.—July 30th, Port Erin, evening, sea calm.

*Peridinium tripos*, few.

Annelid larvæ, several kinds.

*Sagitta bipunctata*, few.

Polyzoon larvæ ? (cf. Mitraria).

Copepoda, very numerous (*Calanus finmarchicus*, *Metridia armata*, *Dias longiremis*, etc.)

Nauplei.

Zoeæ, numerous.

*Evadne nordmanni*, many.

Gastropod larvæ, few.

*Oikopleura flabellum*, very few.

III.—Aug. 1st, Port Erin, mid-day.

*Peridinium tripos*, and *P. furca*.

Diatoms, various species.

*Thaumantias thompsoni*, many; and *T. lucida*.

*Bougainvillia britannica.*

*Pleurobrachia pileus*, few.

Echinopædia, few.

*Tomopteris onisciformis*, one.

*Sagitta bipunctata.*

Nauplei.

Zoeæ.

Copepoda, numerous (*Calanus finmarchicus*, *Metridia armata*, *Dias longiremis*, *Temora longicornis*, etc.).

*Evadne nordmanni*, numerous.

Amphipod, one.

*Oikopleura flabellum*.

IV.—Aug. 7th, Port Erin, mid-day.

*Peridinium tripos*, a few.

Medusoid gonophores, numerous; several species.

*Sagitta bipunctata*.

Copepoda, numerous (*Calanus finmarchicus*, *Metridia armata*, etc.).

*Evadne nordmanni*, few.

Nauplei.

Zoeæ.

Amphipoda, several species.

*Oikopleura flabellum*, few.

V.—Aug. 18th, inside the breakwater, Port Erin, noon.

*Peridinium tripos*.

Medusoid gonophores, several species of *Thaumantias*.

*Sagitta bipunctata*.

Copepoda, few.

*Evadne nordmanni*.

*Oikopleura flabellum*, few.

VI.—Aug. 19th, inside the breakwater, Port Erin, noon.

Medusoid gonophores, numerous (*Thaumantias thompsoni*, and *Thaumantias octona*).

Plutei.

*Sagitta bipunctata*.

Copepoda, fairly numerous (*Calanus finmarchicus*, *Pseudocalanus elongatus*, *Temora longicornis*, *Centropages hamatus*, etc.).

Zoeæ.

*Evadne nordmanni*, a few.

*Oikopleura flabellum.*

Ascidian larvæ.

VII.—Aug. 21st, inside breakwater, Port Erin.

*Peridinium tripos*, very few.

Medusoid gonophores, very many (*Thaumantias hemispherica*, *T. octona*, *T. thompsoni*, and *Bougainvillia britannica*).

Echinopædia, a few.

Annelid larvæ.

*Sagitta bipunctata.*

Copepoda, fairly numerous (*Calanus finmarchicus*, *Dias longiremis*, *Temora longicornis*, *Centropages hamatus*, etc.).

*Evadne nordmanni*, few.

Isopoda, several.

Zoeæ and other larval Crustaceans.

*Oikopleura flabellum*, very numerous.

VIII.—Aug. 22nd, Port Erin, noon; stiff breeze.

*Peridinium tripos*, few.

Medusoid gonophores, numerous (*Thaumantias hemispherica*, *T. thompsoni*, *T. octona*, and *Bougainvillia britannica*).

Plutei, few.

*Sagitta bipunctata*, numerous, and of very large size, up to 16 mm. in length.

Copepoda, fairly numerous (*Calanus finmarchicus*, *Dias longiremis*, *Centropages hamatus*, etc.).

Nauplei and Zoeæ.

*Evadne nordmanni*, few.

Isopoda, several species.

*Oikopleura flabellum*, fairly numerous.

IX.—Aug. 22nd, Port Erin, after sunset; windy.

Medusoid gonophores.

*Sagitta bipunctata.*

*Tomopteris onisciformis.*

Copepoda, various (including *Pleuromma abdominale*, one specimen).

*Evadne nordmanni.*

Isopoda.

*Oikopleura flabellum.*

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The following is the list of species in the collection made on the Southern shores of the Isle of Man, from Fleshwick Bay* to near Castletown, by shore-collecting, dredging, and tow-netting, during five weeks in July and August, 1885.

## PORIFERA.

*Halisarca dujardinii*, off Port St. Mary; also shore, Port Erin, Bay-ny-Carrickey, &c.

*Chalina limbata*, shore, Port Erin.

*Dictyocylindrus stuposus*, off Port Erin.

*Amorphina panicea*, shore, Port Erin, &c.

*Amorphina caruncula*, shore pools, Kitterland.

*Isodictya elegans*, in shore-pool, Port Erin.

*Isodictya densa*, Port Erin.

*Halichondria incrustans*, shore, Bay-ny-Carrickey.

*Cliona celata*, off Port Erin, and off Spanish Head.

*Hymeniacidon sanguinea*, shore pools, Port Erin.

*Ascetta coriacea*, shore, Bay-ny-Carrickey and Port Erin.

*Sycandra compressa*, shore, Fleshwick Bay, Port Erin, etc.

*Sycandra ciliata*, shore, Port Erin.

*Sycandra aspera*, n.sp., off Port Erin.

*Leucandra nivea*, off Spanish Head, twelve to twenty fathoms.

*Leucandra fistulosa*, shore, Port Erin.

* See Chart Pl. XII.

*Leucandra johnstonii*, shore, Bay-ny-Carrickey and Port Erin.

*Leucandra gossei*, off Port St. Mary, &c.

## Cœlenterata.

### Hydromedusæ.

*Clava multicornis*, on *Corallina officinalis*, Port Erin.

*Coryne* sp., on wood of old breakwater, Port Erin.

*Garveia nutans*, off Spanish Head, fifteen fathoms.

*Tubularia indivisa*, dead, off Spanish Head and Port Erin.

*Tubularia simplex* (?) off Spanish Head, fifteen fathoms.

*Eudendrium ramosum*, off Port Erin, ten to twenty fathoms.

*Eudendrium capillare* (?), on *Hyas coarctatus*, off Port Erin.

*Clytia johnstoni*, off Bradda Head, near Port Erin.

*Obelia flabellata*, off Port Erin.

*Obelia dichotoma*, off Port Erin.

*Obelia gelatinosa* (?), Port Erin.

*Campanularia volubilis*, off Spanish Head.

*Campanularia verticillata*, off Port St. Mary, fifteen fathoms.

*Campanularia hincksii*, off Spanish Head.

*Campanularia caliculata*, off Port Erin.

*Campanularia angulata*, off Port Erin.

*Campanularia flexuosa*, off Port Erin.

*Campanularia neglecta*, off Port Erin.

*Gonothyræa lovéni*, off Port Erin.

*Lafoëa dumosa*, off Spanish Head, ten to twenty fathoms.

*Calycella syringa*, off Port Erin.

*Coppinia arcta*, off Spanish Head; shore, Port Erin.

*Halecium halecinum*, off Spanish Head and Port Erin, ten to twenty fathoms.

*Halecium beanii*, off Spanish Head.

*Sertularella polyzonias*, off Port Erin.

*Diphasia rosacea*, on *Tubularia*, off Port Erin.

*Sertularia abietina*, off Spanish Head.

*Sertularia operculata*, off Spanish Head.

*Sertularia pumila*, shore, Port Erin.

*Sertularia filicula*, off Port Erin.

*Sertularia argentea*, off Port Erin.

*Hydrallmania falcata*, off Spanish Head.

*Plumularia pinnata*, off Port Erin, fifteen fathoms.

*Antennularia ramosa*, off Port Erin.

*Antennularia antennina*, off Spanish Head.

### Medusoid Gonophores.

*Thaumantias hemispherica*, surface, Port Erin.

*Thaumantias octona*, surface, Port Erin.

*Thaumantias thompsoni*, surface, Port Erin.

*Thaumantias lucida*, surface, Port Erin.

*Bougainvillia britannica*, surface, Port Erin.

### Ctenophora.

*Pleurobrachia pileus*, surface, Port Erin.

### Actiniaria.

*Halcampa chrysanthellum* (?), off Halfway Rock, Port Erin, ten fathoms.

*Actinoloba dianthus*, shore, Port Erin, Fleshwick Bay.

*Heliactis venusta*, shore, Kitterland, in rock pools.

*Adamsia palliata*, off Spanish Head, ten to twenty fathoms.

*Actinia equina*, Port Erin, Fleshwick Bay, etc.

*Anemonia sulcata*, shore, Bay-ny-Carrickey, Port Erin.

*Tealia crassicornis*, shore, Port Erin. The varieties *insignis* and *purpurea* were also noticed.

*Bunodes gemmaceus*, shore, Bay-ny-Carrickey; shore, Port Erin.

*Corynactis viridis*, off Spanish Head and The Calf, fifteen to twenty-five fathoms. The specimens seemed to belong to the variety *rhodoprasina*, Gosse.

*Polythoa arenacea*, off Spanish Head, ten to twenty fathoms.

ALCYONARIA.

*Alcyonium digitatum*, off Spanish Head, ten to twenty fathoms.

*Sarcodictyon catenata*, off Spanish Head, ten to twenty fathoms.

ECHINODERMATA.

*Antedon rosaceus*, off Port Erin, Halfway Rock; off Spanish Head, ten to twenty fathoms. Pentacrinoid larvæ on Algæ in same locality.

*Asterias rubens*, off Port St. Mary.

*Cribrella sanguinolenta*, off Spanish Head and Port Erin.

*Solaster papposa*, off Port Erin.

*Asterina gibbosa*, shore, Bay-ny-Carrickey, Port Erin, etc.

*Ophioglypha ciliata*, off Port Erin.

*Ophioglypha albida*, off Port Erin, Port St. Mary, etc.

*Amphiura squamata*, Port Erin, Fleshwick Bay, etc.

*Ophiopholis aculeata*, off Port Erin, twelve fathoms, etc.

*Ophiothrix pentaphyllum*, off Spanish Head, common.

*Ophiocoma nigra*, off Spanish Head, fifteen to twenty fathoms.

*Echinus miliaris*, off Spanish Head and Port Erin.

*Echinus esculentus*, common off Port Erin, Port St. Mary, etc.

*Echinocardium flavescens*, off Bradda Head, fifteen fathoms.

*Echinocardium cordatum*, off Port Erin.

*Spatangus purpureus*, one specimen, off Port Erin, fifteen fathoms.

*Echinocyamus pusillus*, off Bradda Head, etc., Port Erin; off Spanish Head.

*Thyone papillosa*, off Cassells, Port Erin, fifteen fathoms.

*Ocnus brunneus*, off Spanish Head, fifteen fathoms.

*Cucumaria hyndmanni*, off Port Erin, twenty fathoms.

### Vermes.

*Leptoplana* sp., off Port Erin, ten fathoms.

*Leptoplana* sp., Port St. Mary, five fathoms.

*Carinella linearis*, off Port Erin.

*Lineus marinus*, between Port St. Mary and Spanish Head, twenty fathoms; also, Bay Fine, ten fathoms.

*Sagitta bipunctata*, surface, Port Erin.

*Hermione hystrix*, off Halfway Rock, Port Erin, and off Spanish Head, fifteen to twenty fathoms.

*Sthenelais zetlandica*, Port Erin, twenty fathoms.

*Polynoe squamata*, off Spanish Head.

*Polynoe floccosa*, Port St. Mary, five fathoms; Bay-ny-Carrickey.

*Hermadion assimile*, on *Echinus*, off Bay Fine, ten fathoms.

*Harmothoë haliæti*, Port Erin, fifteen fathoms.

*Harmothoë imbricata*, shore, Bay-ny-Carrickey, etc.

*Nephthys longisetosa*, Port Erin.

*Syllis armillaris*, Port Erin.

*Nereis pelagica*, shore, Bay-ny-Carrickey, etc.

*Nereis viridis*, shore, Bay-ny-Carrickey, and off Spanish Head.

*Lumbriconereis fragilis*, Port St. Mary.

*Eunice* sp., Port St. Mary.

*Terebella conchilega*, Port St. Mary, five fathoms; etc.

*Terebella nebulosa*, off Port Erin, etc., ten to twenty fathoms; common.

*Dasychone lucullana*, Port Erin.

*Pectinaria belgica*, off Port Erin, twenty fathoms.

*Filograna implexa*, off Port St. Mary, five fathoms.

*Cirratulus cirratus*, off Port St. Mary.

*Cirratulus borealis*, shore, Bay-ny-Carrickey, Port Erin, etc.

*Serpula vermicularis*, off Spanish Head, Port Erin, etc.

*Spirorbis borealis*, Fleshwick Bay, etc.

*Protula protensa*, off Spanish Head, twenty fathoms.

*Tomopteris onisciformis*, surface, Port Erin.

POLYZOA.

*Ætea recta*, off Port Erin, ten to fifteen fathoms.

*Ætea truncata*, on Algæ, Port Erin, ten to fifteen fathoms.

*Eucratea chelata*, var. *elongata*, nov., off Port Erin.

*Scrupocellaria scrupea*, Port Erin, five to ten fathoms.

*Scrupocellaria scruposa*, Port St. Mary, five fathoms.

*Scrupocellaria reptans*, on *Pecten*, etc., off Port Erin.

*Bugula plumosa*, Port Erin.

*Beania mirabilis*, Port Erin, five to ten fathoms.

*Cellaria fistulosa*, off Spanish Head. etc., common, ten to twenty fathoms.

*Cribrilina punctata*, on decayed wood, Spanish Head, fifteen fathoms.

*Membraniporella nitida*, on *Pecten*, off Spanish Head, twenty fathoms.

*Membranipora catenularia*, off Port Erin.

*Membranipora aurita*, on decayed wood, Spanish Head, fifteen fathoms.

*Membranipora pilosa*, off Port St. Mary, five fathoms, etc.

*Microporella malusii*, on *Pecten*, off Spanish Head, twenty fathoms.

*Schizoporella spinifera*, off Port Erin, ten to fifteen fathoms.

*Umbonula verrucosa*, off Port St. Mary, and near Spanish Head.

*Porella compressa*, off Spanish Head, twenty fathoms.

*Smittia reticulata*, on *Pecten*, off Spanish Head, twenty fathoms.

*Mucronella peachii*, on *Pecten*, off Spanish Head, twenty fathoms.

*Mucronella coccinea*, on *Pecten*, off Spanish Head, twenty fathoms; also on *Laminaria* roots, and on *Anomia*, Port St. Mary, common.

*Cellepora pumicosa*, off Spanish Head.

*Crisia eburnea*, off Spanish Head, ten to twenty fathoms.

*Crisia denticulata*, off Port St. Mary.

*Crisia cornuta*, Port St. Mary, five fathoms; shore, Port Erin.

*Diastopora patina*, on *Pecten*, off Spanish Head, twenty fathoms.

*Lichenopora hispida*, on *Pecten*, off Spanish Head, twenty fathoms.

*Alcyonidium hirsutum*, off Port Erin, ten to fifteen fathoms.

*Flustrella hispida*, Port Erin, etc.

*Amathia lendigera*, off Cassells, Port Erin, twelve fathoms.

*Bowerbankia imbricata*, on base of *Amaroucium*, Port Erin.

*Bowerbankia pustulosa*, off Port Erin, ten to fifteen fathoms.

*Cylindrœcium dilatatum*, Port Erin, ten to fifteen fathoms

*Valkeria uva*, var. *cuscuta*, Port Erin.

*Mimosella gracilis*, off Bay Fine, ten to fifteen fathoms.

*Pedicellina gracilis*, and also var. *nodosa*, nov., off Bay Fine.

### Crustacea.

#### Cirripedia.

*Verruca strömia*, on *Laminaria*, Spanish Head.

*Balanus balanoides*, off Port St. Mary, very large.

*Chthamalus stellatus*, shore, Fleshwick Bay.

#### Copepoda.

*Calanus finmarchicus*, surface, Port Erin.

*Pleuromma abdominale*, surface, Port Erin.

*Metridia armata*, surface, Port Erin.

*Pseudocalanus elongatus*, surface, Port Erin.

*Candace truncata* (?), surface, Port Erin.

*Dias longiremis*, surface, Port Erin.

*Temora longicornis*, surface, Port Erin.

*Centropages hamatus*, surface, Port Erin.

*Oithona spinifrons*, surface, Port Erin.

*Ascidicola rosea*, in Ascidian, Port Erin.

#### Amphipoda.

*Iphimedia obesa*.

*Atylus swammerdamii*.

*Atylus gibbosus*.

*Dexamine spinosa*.

*Gammarus locusta*.

*Gammarus marinus*.

*Amphithoë podoceroides*.

*Podocerus falcatus*.

*Podocerus pelagicus*.

*Podocerus pulchellus*.

*Sunamphithoë hamula*.

*Caprella linearis*, shore, Fleshwick Bay.

*Proto pedata.*

*Protella phasma.*

*Chelura terebrans*, great number in wood of old breakwater, Port Erin.

ISOPODA.

*Idotea linearis*, Port Erin, etc.

PODOPHTHALMATA.

*Crangon sculptus*, off Port Erin.

*Galathea intermedia*, off Port Erin, ten fathoms, common.

*Galathea squamifera*, off Spanish Head, ten to twenty fathoms; shore, Bay-ny-Carrickey.

*Pagurus bernhardus*, off Port Erin, etc., common.

*Pagurus prideauxii*, off Port St. Mary.

*Pagurus cuanensis*, off Spanish Head.

*Porcellana longicornis*, off Port St. Mary.

*Pinnotheres pisum*, off Spanish Head, ten to twenty fathoms.

*Portunus pusillus*, shore, Port Erin.

*Ebalia cranchii*, off Port Erin.

*Ebalia tuberosa*, off Port Erin.

*Ebalia tumefacta*, between Port St. Mary and Spanish Head, twenty fathoms.

*Inachus dorsettensis*, off Port Erin.

*Hyas araneus*, off Port Erin.

*Hyas coarctatus*, off Spanish Head.

*Stenorhynchus rostratus*, off Port Erin, ten fathoms.

*Eurynome aspera*, off Spanish Head, twenty fathoms.

PYCNOGONIDA.

*Pallene brevirostris*, off Spanish Head.

*Phoxichilidium femoratum*, Port Erin.

*Pephredo hirsuta* (?), off Port Erin, fifteen fathoms; shore, Fleshwick Bay.

*Phoxichilus spinosus*, off Port Erin, fifteen fathoms.

## Mollusca.

*Anomia ephippium*, off Spanish Head, Port St. Mary, etc.

*Ostrea edulis*, off Port St. Mary, ten to twenty fathoms.

*Mytilus edulis*, off Port St. Mary

*Mytilus modiolus*, off Spanish Head.

*Modiolaria discors*, shore, Fleshwick Bay, Port Erin.

*Modiolaria marmorata*, off Spanish Head, ten to twenty fathoms.

*Lima loscombii*, off Spanish Head.

*Lima elliptica*, off Spanish Head.

*Pecten varius*, young, Port Erin.

*Pecten similis*, off Spanish Head.

*Pecten pusio*, off Spanish Head.

*Pecten opercularis*, off Port St. Mary, etc.

*Pecten maximus*, off Spanish Head.

*Pecten tigrinus*, var. *costata*, off Spanish Head.

*Nucula nucleus*, off Spanish Head, fifteen fathoms.

*Pectunculus glycimeris*, off Port Erin and Halfway Rock, off Spanish Head, etc., ten to twenty fathoms.

*Arca tetragona*, off Spanish Head.

*Venus fasciata*, Port Erin.

*Venus casina*, Port Erin, Port St. Mary, ten to twenty fathoms.

*Venus gallina*, Port Erin.

*Venus exoleta*, off Port Erin.

*Astarte sulcata*, off Port Erin.

*Mactra solida*, and var. *elliptica*, off Port Erin.

*Tapes virgineus*, off Spanish Head.

*Saxicava rugosa*, off Port St. Mary, Spanish Head, etc.

*Psammobia tellinella*, off Spanish Head.

*Tellina balthica*, off Port Erin.

*Cardium norvegicum*, off Port Erin, young.

*Thracia prætenuis*, off Port Erin.

*Pholas crispata*, shore, Bay-ny-Carrickey.

*Chiton cancellatus*, off Port Erin.

*Chiton albus*, Port Erin.

*Chiton cinereus*, off Spanish Head.

*Chiton lævis*, Port Erin.

*Dentalium entale*, off Spanish Head, twenty fathoms.

*Patella vulgata*, common everywhere.

*Patella vulgata*, var. *athletica*, Fleshwick Bay.

*Helcion pellucidum*, var. *læve*, off Port St. Mary.

*Emarginula fissura*, off Port Erin, ten to fifteen fathoms; off Spanish Head.

*Fissurella græca*, off Port Erin, off Spanish Head, fifteen to twenty fathoms.

*Trochus zizyphinus*, off Port Erin, fifteen fathoms.

*Trochus cinerarius*, off Spanish Head; shore, Bay-ny-Carrickey.

*Trochus magus*, off Port Erin, ten to twenty fathoms.

*Trochus tumidus*, off Spanish Head.

*Purpura lapillis*, Fleshwick Bay.

*Lacuna divaricata*, shore, Bay-ny-Carrickey.

*Littorina obtusata*, Fleshwick Bay.

*Littorina littoralis*, Port Erin, etc.

*Velutina lævigata*, off Port Erin.

*Phasianella pullus*, off Spanish Head, fifteen fathoms.

*Buccinum undatum*, off Spanish Head.

*Murex erinaceus*, off Spanish Head.

*Natica catena*, off Spanish Head.

*Natica alderi*, off Spanish Head.

*Fusus gracilis*, off Spanish Head.

*Fusus antiquus*, off Spanish Head.

*Trophon barvicensis*, off Port St. Mary.

*Trophon muricatus*, off Port Erin.

*Pleurotoma nebula*, off Port Erin.

*Pleurotoma turricula*, off Spanish Head.

*Cypræa europæa*, off Port Erin and Port St. Mary.

*Aplysia punctata*, off Cassells, Halfway Rock, Bay Fine, Port Erin, etc., ten to twenty fathoms.

*Pleurobranchus membranaceus*, shore, Bay-ny-Carrickey.

*Doris tuberculata*, shore, Port Erin.

*Eolis lineata*, two specimens, dredged off Port Erin, ten fathoms.

*Eolis picta*, off Port Erin.

*Eolis amœna*, one specimen, off Halfway Rock, Port Erin.

*Eolis tricolor*, off Spanish Head, twenty fathoms.

*Doto fragilis*, off Port Erin; off Spanish Head.

*Dendronotus arborescens*, off Spanish Head, twenty fathoms.

*Goniodoris castanea*, off Spanish Head, twenty fathoms.

## Tunicata.

*Molgula occulta*, many, dredged off Bradda Head, fifteen fathoms; off Spanish Head, twenty fathoms.

*Eugyra glutinans*, off Spanish Head, and off Half-way Rock, ten to twenty fathoms.

*Polycarpa monensis*, n.sp., off Port Erin, fifteen fathoms.

*Polycarpa pomaria*, Bay Fine, twelve fathoms.

*Polycarpa comata*, off Halfway Rock, Port Erin.

*Polycarpa rustica*, on *Laminaria*, Port St. Mary, five fathoms.

*Styela grossularia*, off Port Erin, Port St. Mary, Spanish Head.

*Corella parallelogramma*, off the Cassells, Port Erin, fifteen fathoms; off Spanish Head.

*Ascidia depressa*, shore, Bay-ny-Carrickey.

*Ascidia plebeia*, off Spanish Head, twenty fathoms.

*Ascidia aspersa*, off Port Erin, ten to fifteen fathoms.

*Ascidia virginea*, off Port Erin, ten fathoms.

*Ascidia scabra*, off Port Erin, ten to fifteen fathoms.

*Ciona intestinalis*, off Port Erin, ten fathoms; off Spanish Head.

*Perophora listeri*, off Spanish Head, twenty fathoms.

*Clavelina lepadiformis*, off Bay Fine and Halfway Rock, ten to twenty fathoms; and off Spanish Head, fifteen fathoms.

*Morchellium argus*, off Bay Fine and Halfway Rock; and off Spanish Head, ten to twenty fathoms.

*Morchellioides alderi*, n.sp., shore pools, Port Erin.

*Amaroucium proliferum*, off Port Erin; shore, Bay-ny-Carrickey, etc.

*Amaroucium* sp., Port St. Mary, five fathoms.

*Distoma rubrum*, shore, Bay-ny-Carrickey, Port Erin, etc.

*Distoma vitrea*, shore, Port Erin.

*Distoma* sp., Port Erin, twenty fathoms.

*Botryllus violaceus*, shore, Bay-ny-Carrickey, Port Erin, etc.

*Botryllus morio*, shore pool, Port Erin.

*Botryllus smaragdus*, Port Erin.

*Botryllus schlosseri*, shore, Port Erin, Bay-ny-Carrickey, etc.

*Botryllus pruinosus*, shore, Port Erin and Bay-ny-Carrickey.

*Polycyclus savignii*, off Halfway Rock and Bradda Head, Port Erin.

*Botrylloides albicans*, shore, Port Erin, Bay-ny-Carrickey.

*Botrylloides* sp., Port Erin.

*Botrylloides rubrum*, off Spanish Head, ten to twenty fathoms, common; also shore, Port Erin, etc.

*Botrylloides leachii*, Port Erin.

*Leptoclinum maculosum*, shore, Bay-ny-Carrickey, Port Erin, Spanish Head, etc.

*Leptoclinum asperum*, off Port Erin, and at Bay-ny-Carrickey.

*Leptoclinum durum*, off breakwater, Port Erin, ten fathoms.

*Leptoclinum candidum*, Port St. Mary, five fathoms, etc.

*Diplosoma gelatinosum*, on Zoophytes, etc., Port Erin and Bay-ny-Carrickey.

*Diplosoma crystallinum*, Port St. Mary, five fathoms; shore, Port Erin.

# NOTES on some of the POLYCHÆTA collected by the L. M. B. C.

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This paper deals with—

(1.) The value of the setæ of the Polychæta as specific characters.

(2.) The structure of the following Aphroditidæ:—

(*a.*) *Malmgrenia castanea*, McIntosh.

(*b.*) *Hermadion assimile*, McIntosh.

(3.) On *Pectinaria auricoma*, Müller, and *Pectinaria belgica*, Pallas.

1. With reference to the first of the above subjects, a few remarks may appropriately be made here.

McIntosh* lays great stress on the importance of the setæ as specific characters, and insists on the accurate delineation of typical examples. In speaking of the setæ, he says:—

"It is impossible, for example, to describe too minutely in groups like the Polynoidæ, in which the specific separation rests on so many fine characters The mere statement that a bristle is slender and serrated conveys little more to the mind than the assertion, in comparing the hair of a bat with that of a sheep, that each is serrated. Even some of the most distinguished investigators of the Annelida have failed to appreciate the valuable results derived from a strict and faithful apprehension of the structure of the bristles, the other characters, of course, being duly attended to. The characteristic markings at the tips of the bristles of *Hermadion pellucidum* and *H. assimile*, for instance, shew how valuable such characters will some day be in

* On British Annelida, *Trans. Zool. Soc.*, Lond., ix, 371.

classification. . . The distinctions between many of the species are nice, yet exact, and afford a good field for scientific accuracy in microscopic work."

Bourne* mentions the neuropodial and notopodial setæ as variable in the series of *Polynoë clava* examined by him, but remarks that the characters of *equivalent* setæ were constant.

After a careful examination of the Polynoidæ of the L. M. B. C. collection,† I can scarcely think that the setæ are such trustworthy guides in the identification of species as Prof. McIntosh believes them to be. In the first place, in the individual the setæ vary much, as Bourne observes, not only in colour, but in size, in curve, markings, and serrations. I mounted the entire series of parapodia from three examples of *Harmothoë imbricata*, and was astonished to find that the amount of variation was very considerable. I was fortunately able to mount entire two or three young specimens of *H. imbricata*, and there also the differences between the bristles of the young and those of the adult were observable. I did the same for *Polynoë clava*, with similar result. No doubt, in aberrant Polynoidæ like *Hermadion assimile* (Pl. VIII), the spines are reliable guides, but no one would require to look at the spines to identify such a form.

I agree with Bourne, that comparison of *equivalent* setæ is useful, but with all due deference to so high an authority as Dr. McIntosh, I would feel doubtful of resting the identification of species so much on the character of the setæ as he seems to be inclined to do.‡ I would equally doubt the advisability of trusting too much to the form of the parapodia themselves as is done by Dr. Hj. Théel, in his

* *Trans. Linn. Soc. Lond., Zool.*, 2nd ser., vol. ii, p. 349.

† See Report on the Vermes, p. 144.

‡ Compare "Challenger" Report on Annelides, by Professor McIntosh, F.R.S. Dr. McIntosh does not state, in many cases, from what segment of the body the bristles are taken.

*Annélides Polychètes des Mers de la Nouvelle-Zemble.** As is pointed out by Bourne (*loc. cit.*), the shape of the parapodia is variable in one and the same individual, and equivalent parapodia must in all cases be compared. At the same time, even then the normal shape of the parapodia may be altered by the presence of eggs in the body cavity, the amount of retraction of the acicula, and the condition of the cæca of the alimentary canal. The general appearance, the number of segments, and a typical transverse section require to be more attended to than they are; the merest outline of the form, natural size, with any striking character, seems an accompaniment to a description of new or rare species very much needed.

Since writing the above, I have been glad to find my opinion supported by Hansen, in his Report on the Annelides of the Norwegian North Atlantic Expedition.† I quote the sentences more especially bearing on the point in question. After pointing out that Malmgren has attached especial weight to the distinctive features of the pedal bristles, considering them, indeed, as of generic value, he goes on to say:—

"From what is stated here, a considerable difference might be inferred to exist between the members of the family *Polynoidæ*, and not only as concerns the structure of the bristles, but also with regard to the external anatomical features of the animals. This, however, is not the case, as will at once appear from a glance at Malmgren's own drawings. Indeed, unless carefully examined in detail, it is hardly possible to distinguish between them, so closely do the animals resemble one another. . . . The last feature to adduce as a generic character would be, if justly considered, the structure of the bristles, which are so remarkably alike in well-nigh all *Polynoæ* that very considerable difficulty is frequently experienced in distinguishing between

* *Kongl. Svenska. Vetenskaps-Akademiens Handlingar*, Bandet xvi, No. 3, 1879.

† Den Norske Nordhavs-Expedition, 1876–78, *Zoologi*, *Annelida*, ved G. Armauer Hansen, 1882.

them; and as for types of bristles, there is nothing of the kind, characters founded on such an assumption being altogether spurious. The fact of the dorsal bristles being shorter or thicker than the ventral, or *vice versa*, and that of the ventral bristles being cleft or not cleft at the points, cannot be regarded as typical peculiarities of structure, generic or specific. . . . And this, as I conceive, peculiar unfitness of the bristles to furnish a sure and obvious basis on which might be established a natural division of the Polynoidæ into numerous genera, extends, I think, with equal force to specific diagnoses."

2. Among the Aphroditidæ dredged by the L. M. B. C., are the rare forms, *Malmgrenia castanea*, McI., and *Hermadion assimile*, McI. These seem to merit fuller notice than they have obtained in the general report.*

(*a.*) *Malmgrenia castanea*, McIntosh, *Trans. Zool. Soc.*, vol. ix, p. 376.

*Localities* (by Gwyn Jeffreys).—N. Uist, 90–96 fathoms, 1867, and in 1868.

On *Spatangus purpureus* (near mouth), eighty-five fathoms. Off Valentia, in eighty fathoms, and off Blasquet, in a hundred and ten fathoms, off the Channel Islands.

Six miles north of Great Ormes Head, fourteen fathoms, in ambulacral groove of *Astropecten irregularis* (L. M. B. C.).

The head was not present on the specimens obtained by the L. M. B. C., but according to McIntosh, "the head is slightly pinkish in life, as is also the proboscidian region, two eyes are situated near the posterior border, and two laterally on the anterior prominence. The tentacle is moderately developed, and has a slight enlargement below the tapering tip. The antennæ have brownish pigment a little above the base."

The body is very long, there being about eighty to a hundred segments. McIntosh states that there are fifteen pairs of scales. The scales, which are "reniform" or

* See Report on Vermes, p. 144.

quadrate, and have a dark belt along their anterior margin, are attached to the dorsal surface of the body on every fourth segment (see Pl. VII, fig. 6). Every elytron-bearing segment possesses two protuberances, rounded or quadrate on surface (Pl. VII, fig. 6, *d*), and each forming a low column, about $\frac{1}{16}$ in. high. The surface of the protuberance is attached to a depression in the under surface of the scale to the left (or right, for the right-hand scales of the middle line). The segments which bear the elytra have no dorsal cirri. The non-elytron-bearing segments have cirri (Pl. VII, fig. 6, *a*), but they have also protuberances identical in position, but not in form, with the elytron-bearing protuberances. Both segments intervening between two elytron-bearing segments have similar protuberances (Pl. VII, fig. 6, *b*, *c*). Each of these is a short column, oval in section, having its long axis at right angles to the long axis of the body, and having its internal and external angles produced into horns. These horns on their ventral sufaces, and a considerable portion of the columns, are covered by ciliated epithelium (see Pl. VII, fig. 3), which probably fulfils a branchial function. The scales are arranged so that the left-hand scale overlies the right-hand one. Their posterior margins are inserted between the two branchial protuberances, overlying the anterior and underlying the posterior of these. The dorsal cirri, as stated by McIntosh, are perfectly smooth (Pl. VII, fig. 6, *a*). The bristles are described and figured by McIntosh (*loc. cit.*).

In transverse section the attachment of muscles to the elytron-bearing protuberance is seen (Pl. VII, fig. 1). Two pseudhæmal vessels appear one above the alimentary canal, between the two masses of the dorsal muscles, the other beneath the alimentary canal, and lying in connection with the reproductive follicles and immediately above it. The vessels are not lined by epithelium, and are probably simply portions of the cœlome cut off. The outer wall of the

ventral vessel is covered by large epithelial cells, which on its under aspect become aggregated into a plate with lateral ridges, forming the genital gland (Pl. VII, fig. 2). From these ridges the ova (or spermatozoa) are budded off into the cœlome.* The alimentary canal shews very well the relationship of the intestinal cæca to the intestine itself. Prolongations of these cæca are carried up into the dorsal protuberances (Pl. VII, figs. 1 and 5). Like Bourne, I have not discovered any communication between the scale cavity and the body cavity; the epithelium covering the surface of the knob is entire, even over the attachment of the muscle. Moreover, the epithelial cells bearing the cilia on the "branchiæ" are quite as large as anywhere else, and there are bands of muscle and connective tissue between the superficial epithelium and the wall of the cæcum. The intestine is lined by columnar ciliated epithelium in one or more layers. The epithelial layer is frequently folded, but the folds do not affect the muscular wall. The folds are epithelial only; the muscular wall is extremely thin, consisting of a very few fibres, arranged, the inner layer circularly, the outer longitudinal. The cæca open into the alimentary canal by funnel-shaped openings. The funnel is lined by columnar ciliated epithelium, the cilia being very long and pointing towards the cavity of the intestine (Pl. VII, fig. 5). The cæca are branched and send prolongations into the dorsal protuberances, as above stated. The funnel has a layer of circular muscle, slightly thicker than that forming the body wall of the intestine. The cells lining the cæca are glandular and secretory (Pl. VII, fig. 5), and frequently shew clear superficial portions which often contain concretions. I can scarcely agree with Haswell in considering that intestinal respiration goes on to any great extent, at

* See Haswell, "Monograph on the Australian Aphroditidæ," *Proc. Linn. Soc., N.S.W.*, vol. vii.

least in this form, and in those where, owing to the power of movement of the scales, the muscle layer is well developed. Further, the ova frequently become pushed up to form a distinct layer between the muscle and the wall of the cæcum, so that a considerable thickness of tissue intervenes between the superficial epithelium and the intestinal wall.

Finally, the acicular muscles fill up the cœlome beneath the cæca and intestine (Pl. VII, fig. 1). The muscles are large, and are attached to the inner end of the aciculum only in a radiating manner. The aciculum has a knob-shaped end, which forms a basis for attachment of the muscles. The acicula are, moreover, connected to each other by muscle bands at their bases (Pl. VII, fig. 4).

(*b.*) *Hermadion assimile*, McIntosh, *Trans. Zool. Soc*, ix, 387.

*Localities.*—St. Andrews; west coast of Ireland; south of England; off the Spanish coast, in the "Porcupine" expedition; and, by the L. M. B. C., at Bay Fine, near Port Erin, Isle of Man, in ten fathoms, from a gravelly bottom.

One or two points in the anatomy of this species seem worthy of note.

The alimentary canal does not present the usual branched lateral cæca which are so characteristic of the Aphroditidæ. On the contrary, it presents merely a series of alternate constictions and bulgings, the swellings corresponding to the segmental space. The entire canal is lined by granular columnar non-ciliated cells, corresponding to those found in the cæca of the ordinary type. The parapodia are very large and elongated. McIntosh figures the spines (*loc. cit.*) which are tolerably numerous and more uniform throughout the series of parapodia than one usually finds them. McIntosh mentions the presence of a median tentacle on the head; that was, however, absent in the specimen obtained off the

Manx coast; a very clearly-defined scar was, however, present,* indicating probably the position of the lost tentacle (see Pl. VIII, fig. 1). The proboscis was long, and presented in section a quadrate lumen, owing to the arrangement of the layers of muscle.

Along the ventral surface of the anterior part of the body, more especially upon the ridges formed by the longitudinal muscle bands, a large number of minute globular projections were seen (Pl. VIII, fig. 2). Each projection was ovoid or elliptical in vertical section. Each has a central core, covered by a thick cuticle, which is continuous with the cuticle over the ventral surface of the body. The cuticle over the papilla is faintly striated at right angles to the surface (Pl. VIII, fig. 4). The core is granular and fibrillar, and towards the base shews larger nuclear looking bodies. The core is directly continuous with fibrillæ from nerve fibres, which are abundantly distributed to the ventral surface of the body. The stalk of the papilla is very thin and hyaline in appearance, and contains a central core, composed of fibrillæ, connecting the nerve fibres with the core of the papilla (Pl. VIII, fig. 3). The nervous system is very much flattened dorso ventrally, and gives off very large nerves to the sides of the body, fibres from which supply the above-mentioned papillæ, which are doubtless some form of tactile sense organ not previously noticed.

The specimen examined was a female, and every available space in the cœlome was filled with eggs, which took on carmine staining very deeply.

(*c.*) On the synonymy of *Pectinaria belgica*, Pallas, and *Pectinaria auricoma*, Müller.

*Pectinaria belgica* was described under the synonym of *Nereis cylindraria*, var. *belgica* by Pallas, in his "Miscellanea Zoologica," 1766; and *Pectinaria auricoma* was

described under the synonym of *Amphitrite auricoma* by O. F. Müller, in his "Zoologica Danica," in 1788. Pennant, in his "British Zoology," describes *Amphitrite auricoma*, and mentions, as a synonym, *Nereis cylindraria* of Pallas, that is to say, the variety *belgica* above mentioned. Dalyell, in his "Powers of the Creator," describes *Amphitrite auricoma*, but calls it *Sabella belgica*. Claus, in his "Traité de Zoologie," acknowledges both *P. auricoma* of Müller, and *P. belgica* of Pallas. Gosse acknowledges *P. belgica* only ("Marine Biology"). Similarly, *P. auricoma* is omitted from the List of British Marine Invertebrata, drawn up by a Committee of the British Association, in 1861, and from Forbes's paper in Brit. Assoc. Report, 1850. McIntosh (Ency. Brit., art. "Annelides") figures *P. belgica* of Pallas, after Malmgren. Finally, Möbius ("Zoologische Ergebnisse") acknowledges both *P. auricoma* of Müller and *P. belgica* of Pallas. Apparently, two distinct species are first of all figured and described by Pallas and Müller respectively, Pallas having the precedence in time; Pennant, Dalyell, and others mix up the two species together; more recent authorities omit either one or other, consider them as one species, or acknowledge them to be distinct. It seems worth while to compare Pallas's and Müller's accounts, in order to determine whether there are points of distinction between them of sufficient importance to justify their being separated from each other.

Müller (*loc. cit.*) gives as the specific characters of his *Amphitrite auricoma* the presence of two cirri on either side of the head, and two rigid yellow fans in front. On examining Pallas's drawings of *P. belgica*, his *Nereis cylindraria*, var. *belgica* (*loc. cit.*), the pair of cirri are found to be present on either side of the head, just as Müller describes them in *P. auricoma*; but his figure of the stiff golden comb shews one continuous and uniform series of teeth, not two

series, as in *P. auricoma.* At the same time, Pallas does not distinctly state the condition of the comb in the form he describes. He compares it, however, with *Nereis cylindraria* var. *capensis*, and says: "Maxime insignes in eo (capite) sunt palmulæ binæ (figs. 1, 2; 7, 8, 9, *a*) rotundatæ, factæ ex paleolis seu acicalis planis, auratis, linearis-acutis, interioribus in qualibet palmula sensim minoribus et angustioribus, exterioribus pariter decrescentibus, at latioribus; omnibus versus dorsum leviter recurvatis. Hæ paleolæ itæ carnoso capiti implantatæ sunt, ut imbricatim (instar remigum in ala avis) exteriores interioribus superadcubent." All these characters are equally true of the combs of *P. auricoma.* Further, Pallas refers to a plate on which both var. *capensis* and var. *belgica* are figured; figs. 1 and 2 are of the former, and there the double comb is quite distinguishable, although not very accurately drawn; figs. 7, 8 and 9, however, which are referred to at the same place (see quotation), are of var. *belgica*, and do not shew the binary condition at all, with the exception of fig. 9, which does shew the teeth divided into two series. Dalyell figures (*loc. cit.*) a form which he calls "*Sabella belgica* or *Amphitrite auricoma,*" and in his drawing two combs (whose existence he mentions in the text) are visible.

McIntosh's figure (*loc. cit.*) of *P. belgica* shews the two combs with perfect accuracy and distinctness. Either Pallas's draughtsman * has made an error in most of the figures of *P. belgica*, and failed to represent the comb with sufficient accuracy, hence leading Müller into error when comparing his form with that of Pallas, or Pallas's figures are correct (although his references in the text are wrong), and his species is distinct from that of Müller (for the condition of the comb appears to be the only important difference between the two). Looking at the inaccuracy of the drawings as com-

* It is to be noted that Pallas did not draw his own plate.

pared with var. *capensis* in Pallas's work, and taking into account the indistinctly double series of teeth shewn in figs. 5, 8 and 9 of var. *belgica*, I think that probably the former view is the most likely to be the correct one. In that case *P. auricoma* of Müller disappears, and becomes *P. belgica* of Pallas.

Dalyell, then, is right in considering them as one form, and Malmgren is right in figuring as *P. belgica* a form with a comb in all respects identical with that described by Müller as peculiar to *P. auricoma*. Other writers have probably not compared the original authorities, and so have simply taken for granted the existence of two distinct species. I have reproduced in Plate VIII (figs. 5–7) the original figures of Müller and Pallas in order that they might be compared with that of Malmgren (fig. 8).

## Explanation of the Plates.

### Plate VII.

*Malmgrenia castanea*, McIntosh.

Fig. 1. Transverse section of the body, magnified 50 diameters.

Fig. 2. Transverse section of the sub-intestinal pseudhaemal vessel, magnified 300 diameters.

Fig. 3. Transverse section of the elytron-bearing protuberance, magnified 300 diameters.

Fig. 4. The bases of the acicula, shewing the mode of attachment of the muscles, magnified 300 diameters.

Fig. 5. Transverse section of the alimentary canal and its cæca, magnified 300 diameters.

Fig. 6. The dorsal surface of four segments from the middle of the body, magnified 50 diameters.

## Plate VIII.

Figs. 1–4. *Hermadion assimile*, McIntosh.

Figs. 5–9. *Pectinaria belgica*, Pallas.

Fig. 1. Head and part of the everted pharynx of *H. assimile*, × 10 diameters.

Fig. 2. Vertical section of ventral surface of *H. assimile*, × 50 diameters. *b*. Nervous system.

Figs. 3 and 4. Ventral papillæ of *H. assimile*, × 300 diameters.

Figs. 5 and 6. *P. belgica*, after Pallas enlarged; *a*. Comb.

Fig. 7. *P. belgica*, after Müller (his *P. auricoma*); enlarged.

Fig. 8. *P. belgica*, after Malmgren; enlarged.

Fig. 9. *P. belgica*, from a specimen in the L. M. B. C. collection; enlarged.

# NOTES on VARIATION in the TUNICATA.

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It is often a matter of very great difficulty to fix upon good diagnostic characters in the Tunicata, and to distinguish between allied species, and varieties, and mere individual variations. I propose to discuss in this paper the most reliable characters for making use of in describing the species, and to give examples of some of the variations to which these and other parts of the body of an Ascidian are liable.

In the first place, it is quite absurd to attempt to describe, or even, in most cases, to identify, an Ascidian, without dissection and microscopic examination. As Savigny long ago said,* "Les Ascidies ont l'organisation variée et l'aspect uniforme. La configuration qui leur est affectée ne permet pas que les différences intérieures se manifestent au-dehors par des signes fort sensibles. Aussi les distinctions nécessaires à la parfaite connaissance des espèces sont-elle difficiles à tracer."

In some cases the genus, and even sometimes the family, cannot be determined without dissection. For example, in many museums and other collections, all Simple Ascidians which are incrusted with sand and shell fragments are labelled "*Molgula*," but some of these specimens usually belong to the genus *Eugyra* (to distinguish which the branchial sac ought to be examined), and in

* *Mémoires*, p. 84. 1816.

some cases they belong to *Polycarpa*, a member of the family Cynthiidæ, and they may even be Ascidiidæ (*e. g.*, *Ascidia involuta*, Heller). It is even possible that such forms might be Compound Ascidians, as *Polyclinum sabulosum* and various species of *Psammaplidium* are incrusted with sand, and, in external appearance, mimic the Molgulidæ.

This instance is sufficient to shew how rash it is to attempt to identify a series of Ascidians without a thorough anatomical examination; and it is of the greatest importance that new species should be sufficiently described, not only in their external appearance, but in their internal structure. Most of the older descriptions of Ascidians are, on this account, of little or no value. With a very few exceptions, they consist merely of more or less minute accounts of the external appearance of the animal, and frequently give no clue to even the genus to which the species belonged. Consequently, many of the British Ascidians, both Simple and Compound, require to be carefully re-examined and fully described before they can be referred to their proper genera, and before they can be compared with the species described from other European seas by such careful investigators as Traustedt, Lacaze-Duthiers, von Drasche, and others.

One of the first matters to be determined is, which anatomical characters are of most importance in distinguishing allied species; and, with the view of settling this important point, I have taken advantage of every opportunity afforded me during the last six years, of examining the structural details of large numbers of the commoner British species. While conducting this investigation, I have been greatly struck by the large amount of individual variation present within the limits of a species, even in the case of important organs such as the branchial sac and the tentacles. I have already discussed such individual variations in the case of

some few species in former papers,* but the specimens collected during last summer in Liverpool Bay, taken along with those formerly dredged on various parts of the west coast, have supplied me with additional examples, some of which seem worthy of being recorded. The general conclusion at which I have arrived is that not one of the characters usually employed in the description of species of Ascidians is constant. They are all liable to more or less variation, and, in the case of some of them, the range of variation is very great. I regard the following as the characters which should be attended to in describing a Simple Ascidian :—

1. The External Appearance. This is liable to considerable variation according to the surroundings. The more important points to mention are—the general shape, the position and extent of the area of attachment, the position and condition of the branchial and atrial apertures, their lobes, the condition of the surface (rough, smooth, etc.), the colour, the length (antero-posterior), the breadth (dorsoventral), and the thickness (lateral).

2. The Test. Its consistence (leathery, gelatinous, cartilaginous, etc.), thickness, strength, transparency, colour (on surface and in section), and minute structure. Under the last head may be mentioned the presence and condition of vessels, test-cells, bladder-cells, pigment-cells, etc.

3. The Mantle. Its relative thickness, its transparency and colour, the condition of its musculature, the condition of the branchial and atrial siphons, and any peculiarities of the body as seen on removal of the test.

4. The Branchial Sac. Its relative size, its shape, relative thickness of its walls; the presence of folds, their number, size, and direction; the arrangement of the internal longitudinal bars in relation to the folds, the presence or

* See especially *Journ. Linn. Soc. Lond., Zool.*, vol. xv, p. 329, and *Proc. R. Phys. Soc. Edin.*, vol. vi, p. 256. 1881.

absence of minute plication in the wall, the papillæ on the internal longitudinal bars, the condition of the transverse vessels, the shape of the meshes; the shape, size, and arrangement of the stigmata.

5. The Dorsal Lamina. Its condition, a membrane or languets; if a membrane, its relative size, and the presence and condition of transverse ribs and marginal teeth or processes; if languets, their size and shape.

6. The Tentacles. Simple or compound; their number, size, and arrangement.

7. The Dorsal Tubercle. Its relative size, its position, the peri-tubercular area, the shape of the tubercle, the position of its aperture, and the curving of its horns—if present.

8. To these characters may be added any noteworthy points in regard to the alimentary canal and the reproductive organs.

In describing a Compound Ascidian, besides attending to the above-mentioned characters, or most of them, it is necessary to examine the shape of the body of the Ascidiozooid, the arrangement of the Ascidiozooids in systems (or cœnobii), and the arrangement of the systems in the colony (or cormus).

The test is always liable to be affected by surroundings such as the object to which the Ascidian is attached, still it very frequently affords good specific characters.

The number of lobes surrounding the branchial and atrial apertures is perhaps the most constant of all the external characters, and yet even it is liable to a certain amount of variation; for example, it is the rule for the genus *Ascidia* to have eight branchial lobes and six atrial, but in some species (*e. g.*, *Ascidia mentula*) the number of branchial lobes may be seven or nine, and the number of atrial lobes five. I have seen a specimen of *Ciona intesti-*

*nalis* with only six lobes, in place of eight, round the branchial aperture.

The mantle very rarely gives definite characters which can be made use of in specification, but, in some cases, its proportions and the general appearance of its musculature afford indications to those who are familiar with the species. The mantle is also of importance in distinguishing some genera (*e.g.*, *Ciona* and *Molgula*).

Probably the most important organ is the branchial sac. It gives characters which serve to distinguish families, genera, and species. Its larger features, such as the presence or absence of folds, and the arrangement of the internal longitudinal bars, are of great importance in classifying the Simple and Compound Ascidians, and these characters are constant.

Other less conspicuous features, such as those derived from the transverse vessels, the meshes, and the stigmata, are useful in distinguishing species, and should always be described, but they are liable to a great deal of variation, especially towards the dorsal and ventral edges of the sac. (Figure 8 on Plate IX. shews an example of this in the case of *Ascidia plebeia.*) Consequently, the part of the wall selected for examination should be taken from about the middle of one side of the branchial sac.

It is not uncommon in the Ascidiidæ to find that, towards the edges of the sac, the internal longitudinal bars become broken up and imperfect, so as to be reduced to irregular split papillæ, attached to the transverse vessels at the corners of the meshes (Pl. IX, fig. 8). I figured this condition in 1880,* in the case of an *Ascidia*, and in 1882,† in *Corella japonica*; since then I have met with it in a number of other species of Simple Ascidians, and

* *Journ. Linn. Soc., Zool.*, vol. xv, pl. xvi, fig. 6.

† "Challenger" Expedition Report, Zool., No. xvii, pl. xxvi, fig. 8.

one of the new Compound Ascidians, obtained during the "Challenger" expedition, *Tylobranchion speciosum*, from Kerguelen Island, has a number of branched papillæ on the transverse vessels of the branchial sac, which are, I believe, simply connecting ducts with rudimentary internal longitudinal bars attached to them. Similarly, I am inclined to regard the small papillæ which project from the transverse vessels in *Perophora listeri* as being really connecting ducts upon the ends of which internal longitudinal bars might possibly have been developed. Figures 1 to 4 on Plate IX. shew a series of stages by which a complete internal longitudinal bar (fig. 1, *i. l*) might be reduced to simple papillæ, projecting from the transverse vessels at the angles of a mesh (fig. 4, *c. d*). All these stages may be seen as irregularities or variations in the branchial sacs of some British Ascidians.

In describing the shape of the meshes and the number of stigmata they contain, it is necessary to avoid the edges of the sac, since the dorsal and ventral rows of meshes are usually very much larger than the rest, and sometimes contain twice as many stigmata. In some branchial sacs the stigmata are, as individual varieties, exceedingly irregular in their arrangement, and this appears to be especially the case where there are several orders of transverse vessels present (*e.g.*, large, small, and medium-sized vessels, arranged alternately), some stigmata being twice or even thrice as long as their neighbours (see Pl. IX, fig. 5).

The small transverse vessels (or horizontal membranes) are very inconstant, and cannot be depended upon. In those species where they occur, they may be present in one mesh, dividing it horizontally into two parts, and absent in all the neighbouring meshes, or they may be present in nearly every mesh of the sac (Pl. IX. figs. 5 and 6, *tr''*). In some cases, they interrupt the stigmata, while in others the stigmata pass

continuously behind the horizontal membranes from one transverse vessel to the next. Roule, in his important work on the Simple Ascidians of the coasts of Provence,* seems to consider that these horizontal membranes, or transverse vessels of the third order, are characteristic of *Ciona intestinalis*, and also that they are always present in the branchial sac of that species. The fact is that (1) the horizontal membranes are present in many other species of Simple Ascidians, and (2) that they are liable to variation in *Ciona intestinalis* just as they are in other cases. I figure here (Pl. IX. fig. 6) a part of the branchial sac of a specimen of *Ciona intestinalis* from the Isle of Man, which shews the delicate vessels in question present in some meshes and absent in others.

The endostyle is not of much value as a diagnostic feature. Its characters are very much the same in all allied species.

The dorsal lamina is of importance. In the different species of the Ascidiidæ it presents all intermediate conditions between a plain broad membrane (the true dorsal lamina) with a straight margin, and a series of long tentacle-like languets. *Ascidia plebeia* is particularly instructive in connection with these intermediate stages. This species has a true dorsal lamina, but the membrane is crossed by transverse ribs or ridges, and, at the margin, these are continued into projecting teeth or processes. In some specimens the

* *Annales du Musée de Marseille, Zoologie*, tome ii, Memoire No. 1, 1884. I take this opportunity of correcting an erroneous statement made by M. Roule in a footnote on page 212 of his work. In referring to woodcut fig. 9 of the first part of my Report upon the "Challenger" Tunicata, he says that I have erroneously represented the viscera of *Ascidia* on the right side of the body in place of on the left. That is not the case. My figure represents a transverse section of the body, viewed from its anterior surface. The top is dorsal. The animal's right side is on the observer's left, and the viscera are placed on the left side of the branchial sac, as they ought to be.

marginal teeth are slight, but in others they are long tentacle-like projections comparable with languets.*

The tentacles at the base of the branchial siphon are of considerable value in characterizing species, genera, and families. In most Ascidians they are simple elongated processes, but in the Molgulidæ, and in two sub-families of the Cynthiidæ, they are compound and branched. In many species the tentacles are of two or more sizes, and the different orders are arranged with regularity. The smaller and more numerous tentacles are always the most liable to variations, such as suppression, reduplication, and irregularity in position. Sometimes, in place of all the tentacles springing from the same line, one order is inserted further forward or further back than the others. This is sometimes the case in *Ascidia plebeia*, † and I have recently found the same condition in a Compound Ascidian ‡ (*Botryllus smaragdus*).

The dorsal tubercle, which is the more or less complicated aperture of the duct from the subneural gland, is a very variable organ, and must be used with great caution in characterizing species. I have already discussed elsewhere § the range of variation of the dorsal tubercle in some of the commoner species of British Ascidians, and, in examining the collection of Tunicata from Liverpool Bay, I have met with some marked cases of variation in this organ. In a specimen of *Polycarpa pomaria*, a species in which the dorsal tubercle is usually cordate in outline, it was found to be a complete ring—a condition sometimes seen as a variation in *Styela grossularia*. In a specimen of *Molgula occulta*, again, one of

* See Pl. VI. fig. 5, *l*, illustrating the Report upon the Tunicata of the L. M. B. C. district, in this volume.

† See *Journ. Linn. Soc., Zool.*, vol. xv, pl. xix, fig. 4.

‡ See Pl. VI., fig. 7, illustrating the Report upon the Tunicata of the L. M. B. C. district, in this volume.

§ Especially in *Proc. R. Phys. Soc. Edin.*, vol. vi, p. 256. 1881.

the horns of the dorsal tubercle was found to bifurcate, a condition which has apparently not been previously noticed.

Some Ascidians vary greatly in the amount, the position, and the colours of their pigmentation. *Ascidia scabra* and *Ascidia virginea* may be mentioned as being particularly variable in this respect. I have recently examined a large number of specimens of *Ciona intestinalis*, in the living condition, from the Isle of Man and other parts of the west coast, with the view of determining what amount of variation exists in regard to the two conspicuous red pigment spots placed in that species near the anterior end of the body, one on the dorsal and the other on the ventral edge (see Pl. IX. fig. 7) of the branchial sac.

The dorsal pigment spot (Pl. IX. fig. 7, and fig. 9, *d. p.*) is a rounded mass placed on the outer (*i.e.* dorsal and anterior) surface of the nerve ganglion; it must not be confused with the pigmented glandular mass of the same colour placed a little further back, upon the anterior extremity of the vas deferens, and which is regarded by Roule * as a renal organ. The ventral pigment spot (Pl. IX. fig. 7, and fig. 10, *v. p.*) is a mass of crescentic form which curves round the anterior extremity of the endostyle, in front of the peripharyngeal bands (Pl. IX. fig. 10, *v. p.*).

After noticing these red spots in many specimens of *Ciona intestinalis*, it was natural to conclude that they are always present in the species, and consequently, I was rather astonished to find that amongst half a dozen specimens, living in a small aquarium, two had no pigment spots at the anterior end of the body. I then examined, in the fully expanded condition, every specimen of *Ciona intestinalis* which I dredged until one hundred and fifty had been collected. This series shewed that the four possible variations in regard to the pigment spots—viz., with both spots present,

* *Recherches sur les Ascidies Simples des Côtes de Provence*, p. 170. 1884.

with both absent, with only the dorsal spot, and with only the ventral spot—were all found. The specimens examined were all of moderate size, and, consequently, immaturity could not account for the absence of the pigment in any of the cases.

The following table shews the number of individuals with each particular variation in the first twenty, the next eighty, and the last fifty specimens examined:—

| Number of specimens examined. | With both pigment spots present. | With only the dorsal spot present. | With only the ventral spot present. | With neither of the spots present. |
|---|---|---|---|---|
| 20 | 10 | 3 | 2 | 5 |
| 80 | 28 | 6 | 14 | 32 |
| 50 | 26 | 3 | 7 | 14 |
| 150 | 64 | 12 | 23 | 51 |

So far as these numbers go, they shew that about two-thirds of the individuals of *Ciona intestinalis* have the anterior end of the body pigmented, and more than half of those (about one-third of the whole) have both the pigment spots present. Of the four conditions found, that with both spots and that with neither are the most frequently met with, while specimens with the dorsal pigment spot alone are rarer than those with a ventral spot only. These spots are merely aggregations of round pigmented connective-tissue cells in the mantle. Their function, if they have any definite function, is still unknown.

## Explanation of Plate IX.

Figs. 1–4. Variations in the internal longitudinal bars and connecting ducts of Simple Ascidians.

Figs. 5 and 6. Variations in the branchial sac of *Ciona intestinalis*, × 50 diameters.

Fig. 7. Anterior end of *Ciona intestinalis*, showing pigment spots, enlarged.

Fig. 8. Imperfect internal longitudinal bars of *Ascidia plebeia*, × 50 diameters.

Fig. 9. Dorsal pigment spot, &c., of *Ciona intestinalis*, × 300 diameters.

Fig. 10. Ventral pigment spot, &c., of *Ciona intestinalis*, × 300 diameters.

*at*, atrial aperture; *br*, branchial aperture; *c.d*, connecting duct; *d.p*, dorsal pigment spot; *d.t*, dorsal tubercle; *en*, endostyle; *h.m*, horizontal membrane; *i.l*, internal longitudinal bar; *l.v*, fine longitudinal vessel; *n.g*, nerve ganglion; *n*, nerves; *p.p′*, large and small papillæ; *p.p*, peripharyngeal band; *sg*, stigmata; *tr*, *tr′*, *tr″*, transverse vessels; *v.p*, ventral pigment spot.

# On a NEW SPECIES of SYCANDRA.

By R. J. Harvey Gibson, M.A., F.R.S.E. F.R.M.S.,
DEMONSTRATOR OF ZOOLOGY IN UNIVERSITY COLLEGE, LIVERPOOL.

In the collection of worms dredged off the south end of the Isle of Man, a specimen was found which, at first sight, seemed to be extremely like the rare and interesting genus *Chætoderma,* and as such was labelled and put aside for further examination. When, however, it was sectionized and examined in detail, it was soon found to be a calcareous sponge.

In shape it is fusiform, the narrower end being provided with a slight rim or fold (Pl. X, fig. 1). Its length is 8 mm.; its breadth, at the narrow end, 1 mm.; at its thickest part, 3½ mm.; and at the terminal opening 1½ mm. The entire surface of the body is studded with blunt-headed calcareous spicules, which had at first suggested the possibility of its being a *Chætoderma.*

In transverse section (Pl. X, fig. 2) the usual poriferal characteristics appear, namely, a central cavity communicating with the exterior by a series of closely placed ciliated canals or chambers. The chambers are ovoid in horizontal section, communicating with the interior and exterior by slightly-constricted openings. These were well seen on the sloughing of the superficial layer of tissue and spicules, which took place when the animal was put in gum, as a preliminary to freezing and sectionizing. In a section taken from the centre of the thickest portion of this body, twenty-eight of these chambers are seen in horizontal section. They lie in a hyaline syncytium, containing a number of

branched granular corpuscles (Pl. X, fig. 3, 4). The chambers themselves are lined by cubical granular nucleated endoderm, each cell having the characteristic collar and cilium (see Pl. X, fig. 4). In the syncytium, externally, internally, and between the chambers, the spicules are placed. These are of four different forms. Inserted between the chambers, as a rule, are long club-shaped spicules, the pointed ends plunged into the syncytium, while the clubbed heads are free and extend for some distance beyond the surface of the body (Pl. X, fig. 3). In addition to these spicules, there are also a large number of the ordinary triradiate type, some large and T-shaped, others much smaller, and having their rays diverging at equal angles to each other (Pl. X, fig. 5). Amongst these are short needle-shaped spicules, lying irregularly in the syncytium; these might, however, be the broken ends of the club-shaped forms.

None of the species described by Hæckel* seems to agree with this form, nor have I been able to place it under any of the species described by more recent authors. The club-shaped spicules, which were generally in pairs, lying close together, seem to be characteristic, and it is probably new to science.

The specific diagnosis is as follows :—

*Sycandra aspera*, n. sp. (Pl. X, figs. 1–7).

Shape.—Elongated and fusiform, attached by one end.

Size.—8 mm. long, and from 1 to 3·5 mm. in breadth.

Spicules.—Four different forms—large and small triradiates, short straight spicules, and large club-shaped spicules, whose bent blunt ends extend outwards beyond the surface of the body.

Locality.—Off the south end of the Isle of Man, depth fifteen fathoms.

* *Die Kalkschwämme*, 1872

## Explanation of Plate X.

Fig. 1. *Sycandra aspera*, n.sp., × 8 diameters. *a*. Superficial layer sloughed, and shewing the openings of the ciliated chambers. The natural size is indicated at the side.

Fig. 2. Semi-diagrammatic transverse section of the body. *a*. Ciliated chamber; *b*. syncytium.

Fig. 3. Body-wall, transverse section, × 50 diameters. *a*. Club-headed spicules. *b*. Needle-shaped spicules; *c*. connective tissue cells; *d*. triradiate spicules; *e*. cavity of ciliated chamber, with epithelium wanting; *f*. do. do. with epithelium.

Fig. 4. Part of wall of a ciliated chamber, × 300 diameters. *a*. Connective tissue cells; *b*. epithelium.

Fig. 5. Triradiate spicule, large size, × 60 diameters.

Fig. 6. Club-headed spicules, × 60 diameters.

Fig. 7. Triradiate spicule, small size, × 60 diameter.

# NOTE on the possible Naturalization of the American Clam, VENUS MERCENARIA, on the Coasts of Lancashire and Cheshire.

BY THOMAS J. MOORE,

CORR. MEMB. ZOOL. SOC., LONDON,
CURATOR OF THE LIVERPOOL FREE PUBLIC MUSEUM.

VARIOUS attempts having been made to naturalize the Quahaug or American Hard-Clam, *Venus mercenaria*, in our local waters, Prof. Herdman has asked me to give a summary account of them.

In February, 1869, Capt. John H. Mortimer, commander and part owner of the ship "America," entrusted to my care a considerable supply of live Clams. A portion was sent to Mr. Frank Buckland, who, I believe, laid them down in his enclosure at Reculvers, but of which I have heard nothing more.

The remainder were divided into lots and cast into the sea at Southport, at the Great Burbo Bank, and at Crosby. At Crosby they were carefully placed by Mr. Frank Archer, assisted by Mr. R. Paden, of the Museum staff. Mr. Archer and others kept a long and careful look-out for results, but none have been forthcoming beyond the rumoured finding of a doubtful valve. This distribution is referred to in the *Proceedings of the Lit. and Phil. Soc., Liverpool*, vol. xxxiii, p. 192.

In February, 1883, Mr. F. P. Marrat printed, for distribution among his friends and correspondents, a record (a few copies of which he still has on hand) of some valves of *Venus mercenaria*, found in the previous September at Hilbre, by Mr. Geo. W. Shrubsole, of Chester, and subsequently by

Mr. J. Chard, of the Museum staff. "Over a hundred single and double valves came into Mr. Shrubsole's possession." On these Mr. Marrat remarks (and I thank him for permission to quote from his paper) that, "although none of the specimens contained the living animals, yet the condition of the shells found as above is that of fresh and not of dead specimens, the ligaments being unbroken, and the interior glassy; and many of them were so small, as not to be likely to have been worth importing for table use."

There was no evidence to induce the supposition that these specimens were descended from the 1869 distribution. On the contrary, personal testimony was given by Mr. F. T. Paul, F.R.C.S., that a recent resident, Mr. H. D. Brandreth, carrying on business in Liverpool, and living on Hilbre Island, which he rented for a time, had certainly laid down Clams (as well as American oysters) in the sea near Hilbre.

On the 28th of April, 1884, I communicated to the Literary and Philosophical Society (*Proceedings*, vol. xxxviii, p. xc), the following particulars of another distribution :—

In the month of May, 1883, a barrel of living specimens of the Quahaug or American Hard-Clam, *Venus mercenaria*, was sent to the Museum, from New York, by Captain J. H. Mortimer, Premier Associate of the Society, through the kind offices of Capt. Hamilton Perry, R.M.S.S. "Britannic," for the purpose of laying down on the neighbouring shores with a view to naturalization. A few specimens were placed in the Museum Aquaria, and, notwithstanding the extremely limited accommodation afforded by the small glass vessels in which they were placed (only twelve inches in diameter with three inches depth of sand), several are still living, and prove that the Molluscs were in healthy and favourable condition on arrival.

In reference to the planting of these Clams, Mr. F. P. Marrat kindly accompanied me, on the 19th May, to the Hoylake shore, at low water, with a view to distributing a portion there, but not thinking it sufficiently promising, we contented ourselves with casting a number into the stream beyond the bridge above the Great Float, or Birkenhead line of docks.

Subsequently I cast a larger number of Clams into the Dee, near Queen's Ferry, also at low water: and, to multiply chances, placed a few score at the disposal of Mr. Alfred O. Walker, of Chester; others I gave to Mr. Shrubsole; and both gentlemen placed them in favourable parts of the Dee.

Up to the present date, March 16th, 1886, no further captures of any kind have come to my knowledge. In the event of any such being made, both Mr. Marrat and myself will be pleased to hear of them.

The Liverpool Marine Biology Committee is indebted to the following gentlemen for assistance:—

To Mr. GEORGE HOLT, Mr. J. POOLE, and Mr. N. RUNDELL, Junr., for the use of steam-tugs for the dredging expeditions.

To Mr. R. D. DARBISHIRE and Mr. T. J. MOORE, for the use of apparatus.

To the SENATE of University College, for permission to use the Zoological Laboratory for Committee meetings, etc.

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| W. R. Melly ... ... | 0 | 10 | 0 |

## PLATES.

Plate I. illustrates Mr. SIDDALL's Report on the *Foraminifera* (p. 42).

Plate II. illustrates Prof. HERDMAN's Report on the *Alcyonaria* (p. 120), and Dr. ELLIS' Report on the *Actiniaria* (p. 123).

Plate III. illustrates Mr. LOMAS' Report on the *Polyzoa* (p. 161).

Plate IV. illustrates Mr. FOWLER's Report on the *Amphipoda* (p. 212), and Mr. THOMPSON's Report on the *Copepoda* (p. 201).

Plates V. and VI. illustrate Prof. HERDMAN's Report on the *Tunicata* (p. 281).

Plates VII. and VIII. illustrate Mr. HARVEY GIBSON's Notes on the *Polychæta* (p. 342).

Plate IX. illustrates Prof. HERDMAN's Notes on the *Tunicata* (p. 354).

Plate X. illustrates Mr. HARVEY GIBSON's Note on *Sycandra* (p. 365).

Plate XI. Chart of Liverpool Bay (the L. M. B. C. District).

Plate XII. Chart of the Southern end of the Isle of Man (see p. 318).

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FIG 1.

FIG 2

FIG 3

J D Siddall, Del.

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FIG. I. PLACOPSILINA KINGSLEYI, n. sp. x 40 dia.
FIG. 2. REOPHAX MONILIFORME, n. sp. x 50 dia.
FIG. 3. MILIOLINA SPICULIFERA, n. sp. x 100 dia.

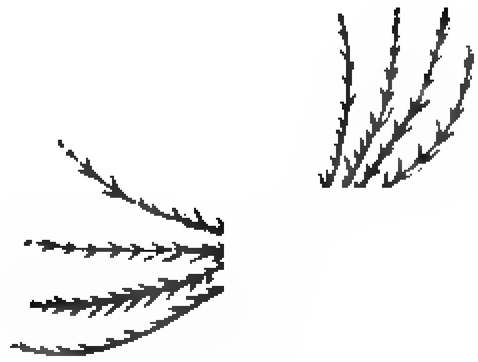


FIG 1

FIG 2

SARCODICTYON CATENATA. Forbes

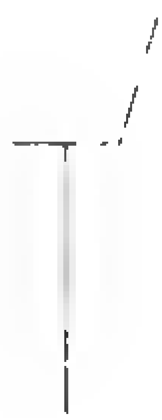
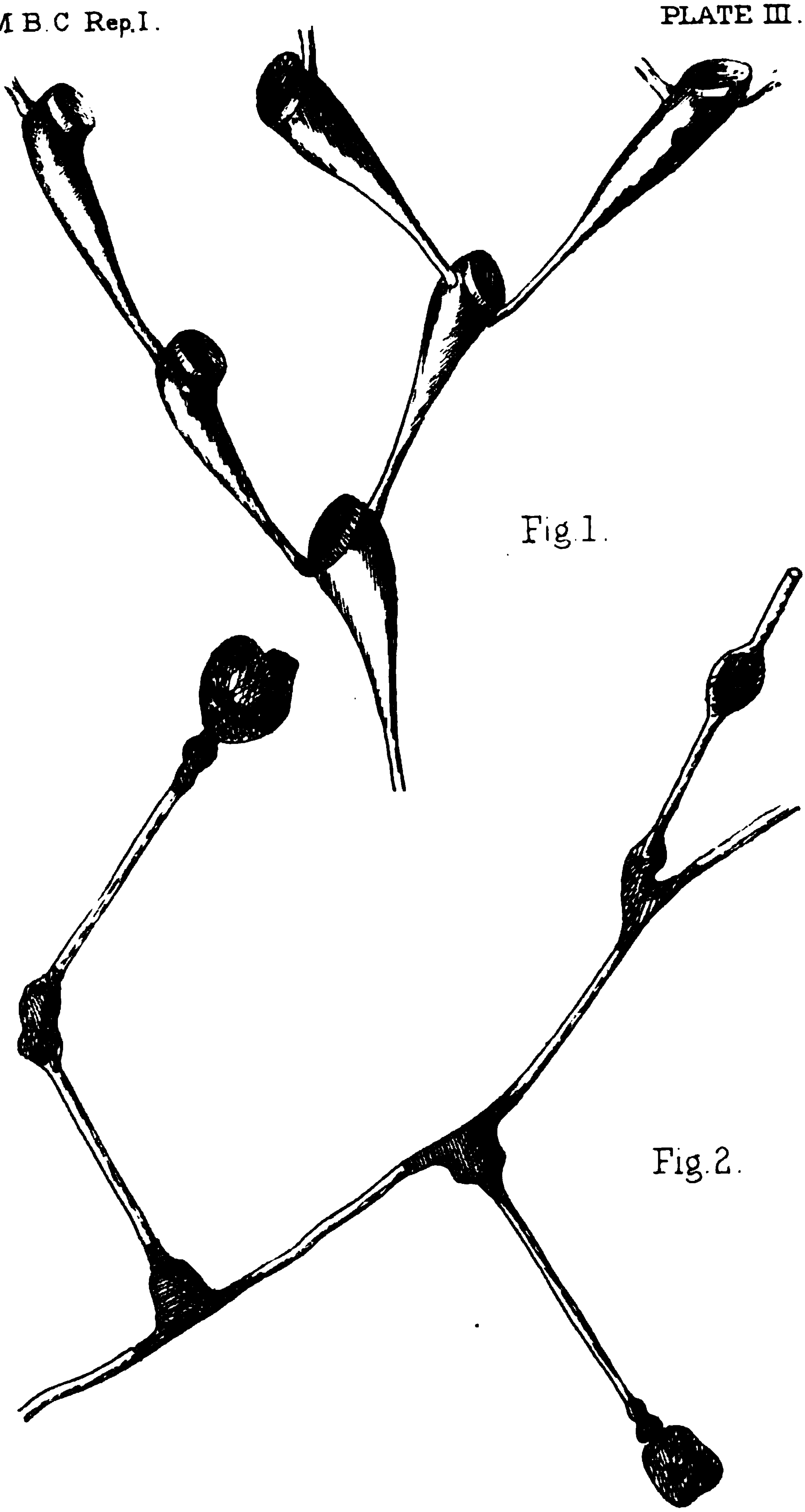


FIG 3

FIG 4

CYLISTA UNDATA, var CANDIDA. nov.




J. Lomas. del et lith.

Fig. 1. EUCRATEA CHELATA, var ELONGATA, nov

Fig. 2. PEDICELLINA GRACILIS, var NODOSA, nov.

PLATE IV

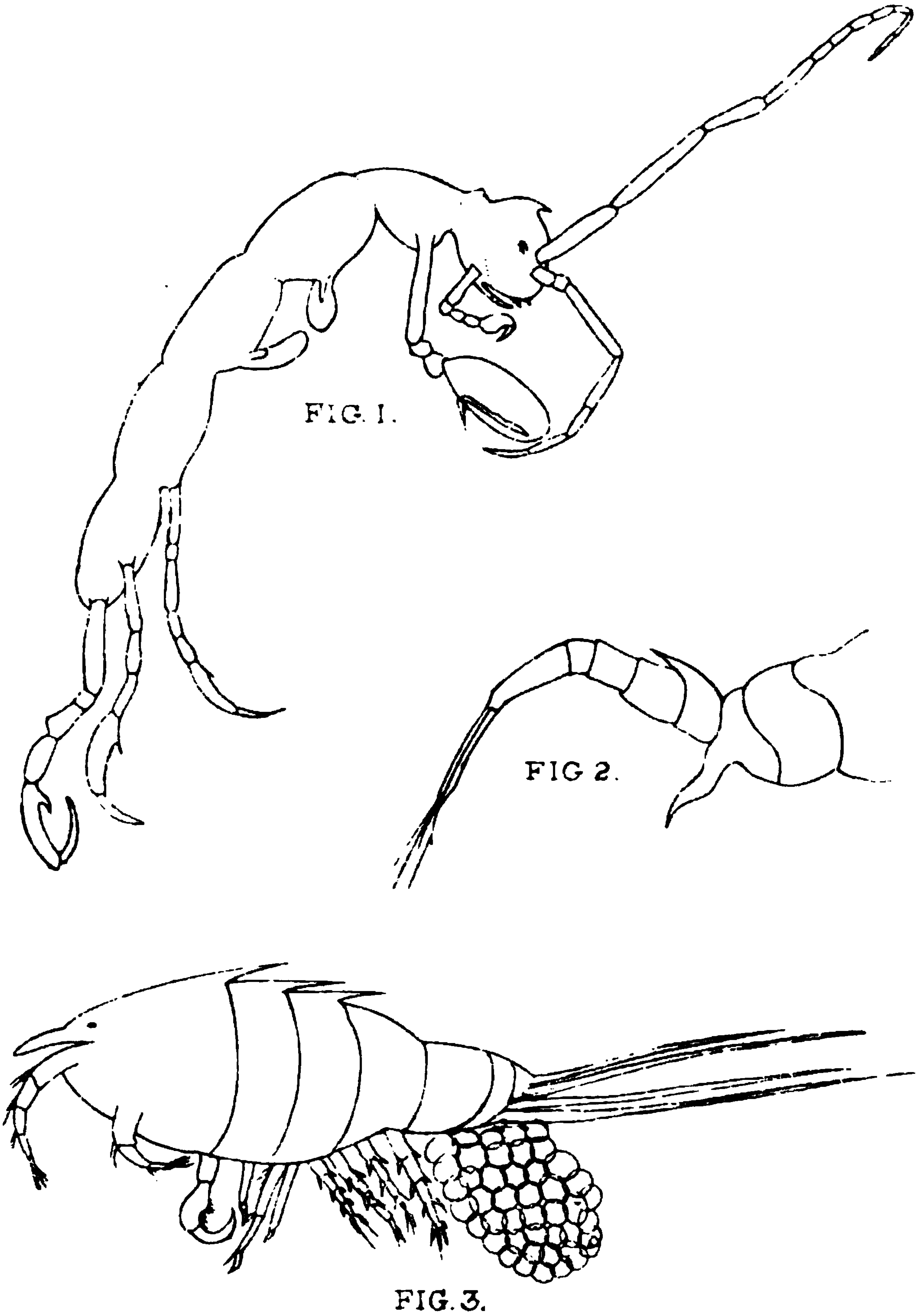


FIG. 1.

FIG 2.

FIG. 3.

G H. Fowler and
I C Thompson Del.

J MARPLES & C° LITH. LIVERPOOL

Fig. 1. PROTELLA PHASMA, Dana. (young)
Fig. 2. ANOMALOCERA PATERSONII, Temp.
Fig 3. HARPACTICUS CHELIFER, Müll

Fig. 1.

m f

Fig 2

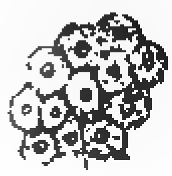


Fig. 3.

Fig. 4.

Fig. 5.


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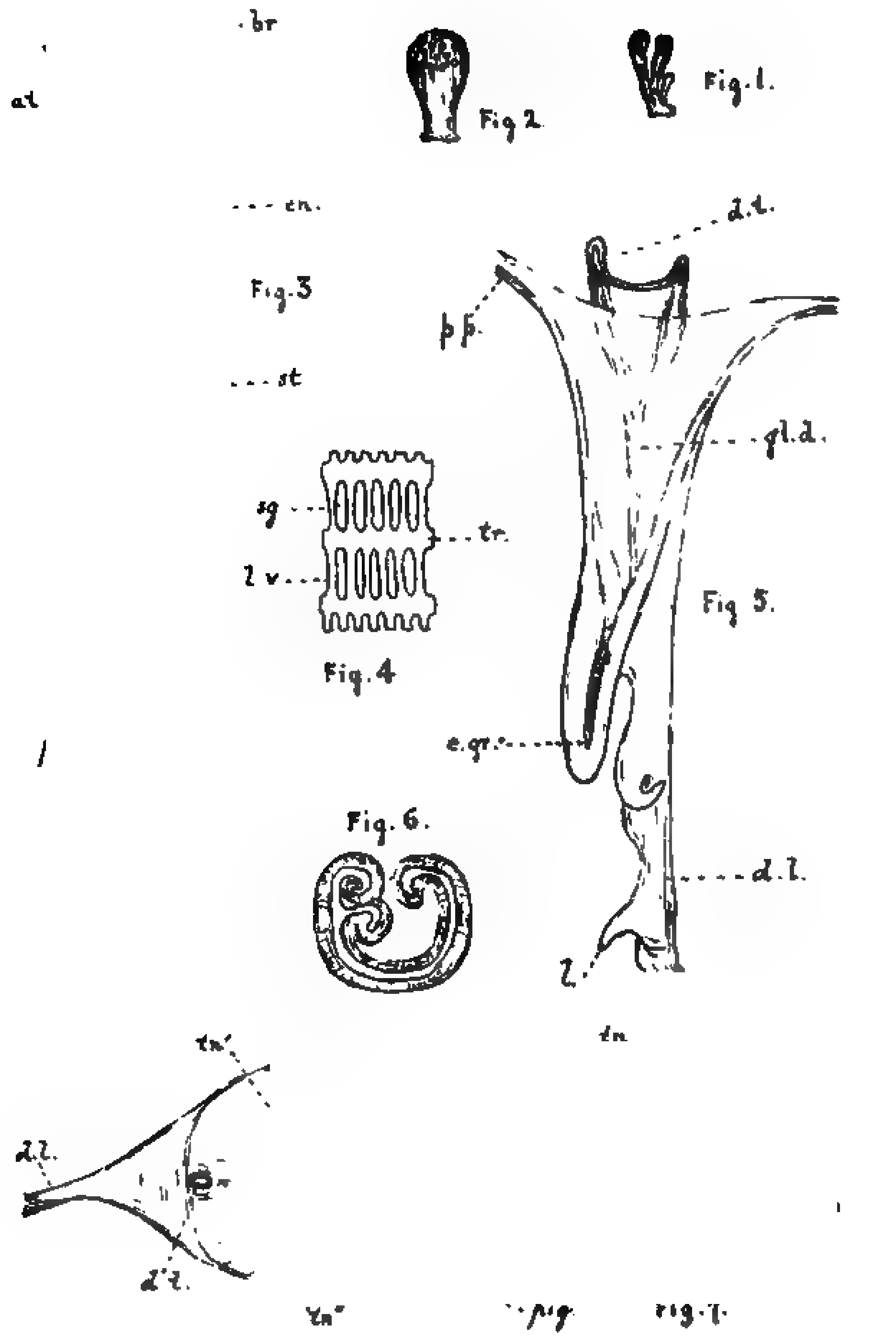
Fig. 6.


Fig. 7.

Fig. 8.

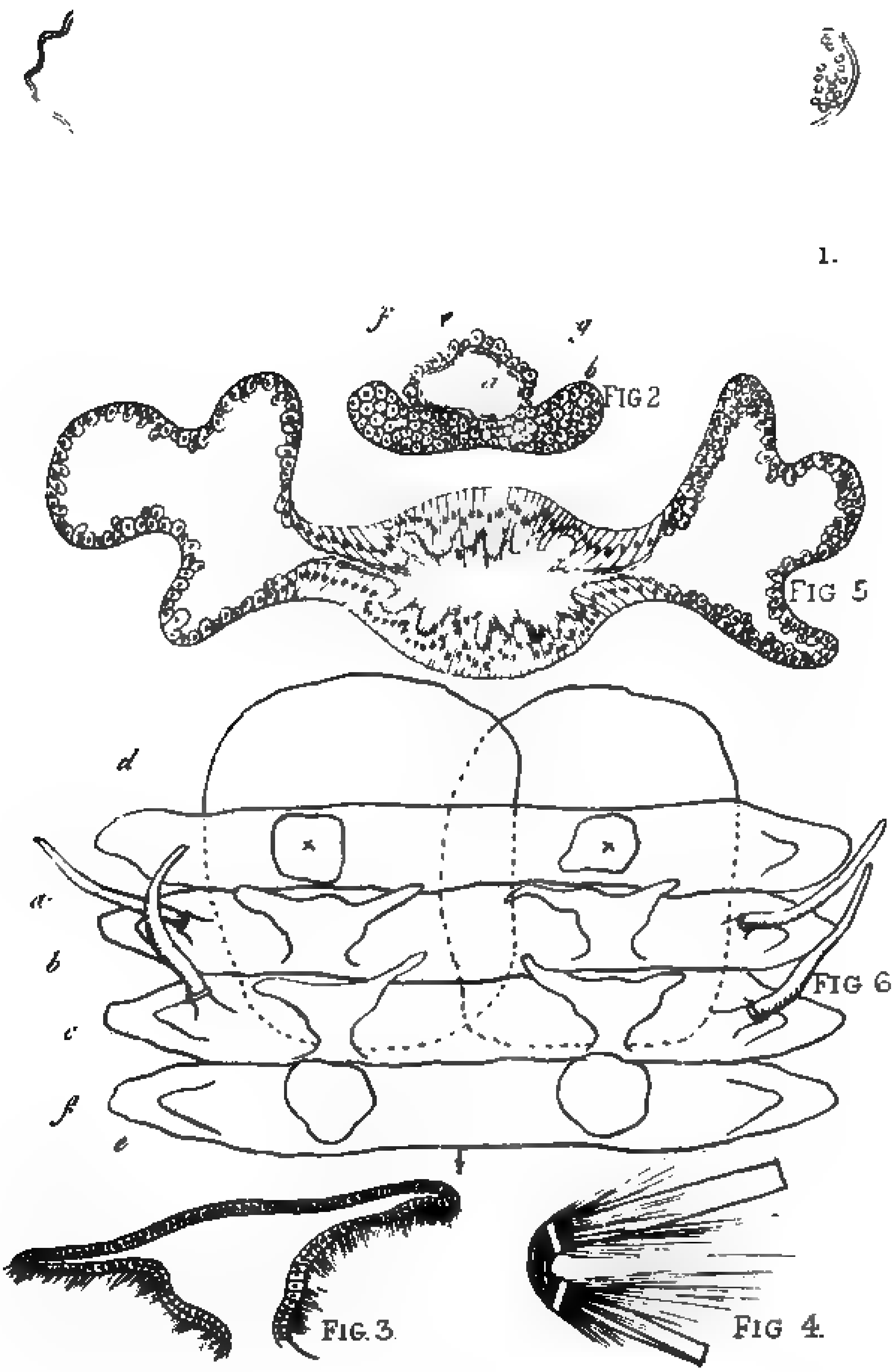
W A H

POLYCARPA MONENSIS, n sp.




W.A.H.

Figs 1-4 MORCHELLIOIDES ALDERI, n. sp.
Fig 5 ASCIDIA PLEBEIA, Alder.
Fig 6 MOLGULA OCCULTA, Kupffer.
Fig 7 BOTRYLLUS SMARAGDUS, M. Edw.




R. J. H. G. Del.

MALMGRENIA CASTANEA, Mc Intosh.

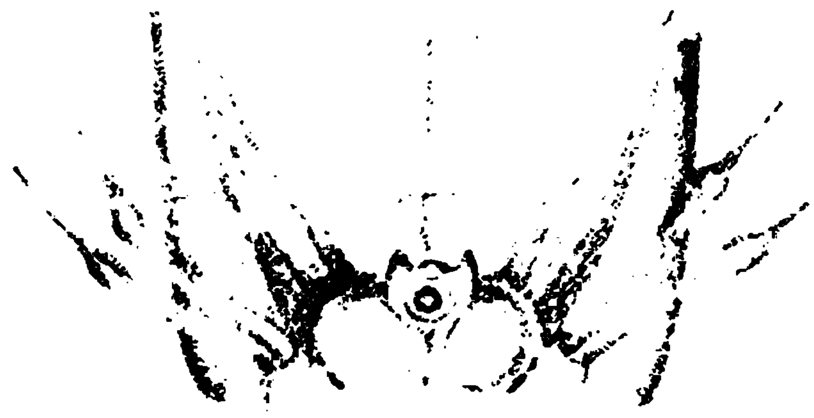


FIG. 1.

FIG. 3.

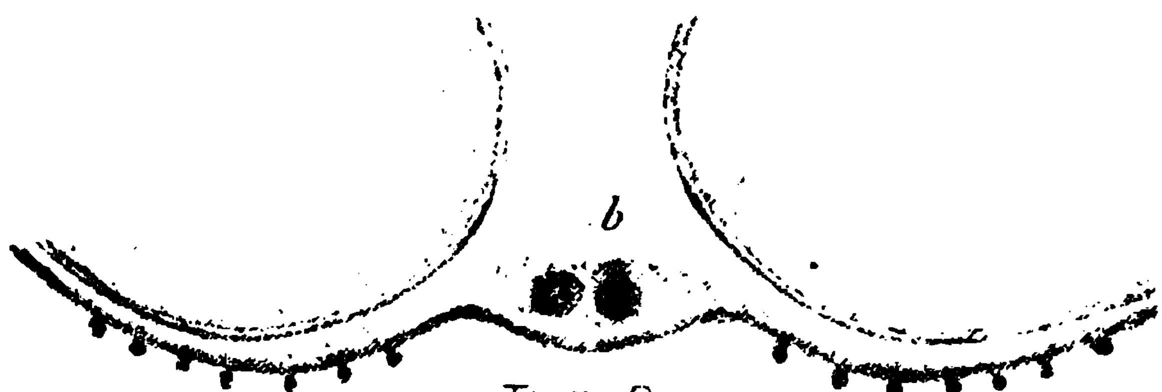
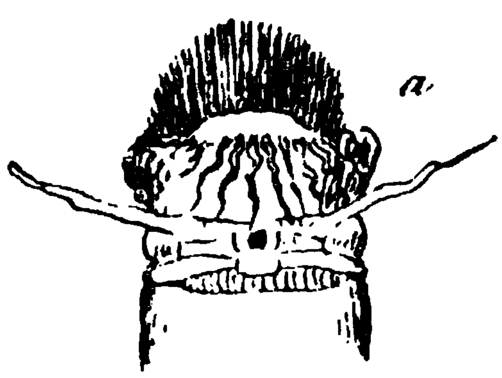



FIG. 2.

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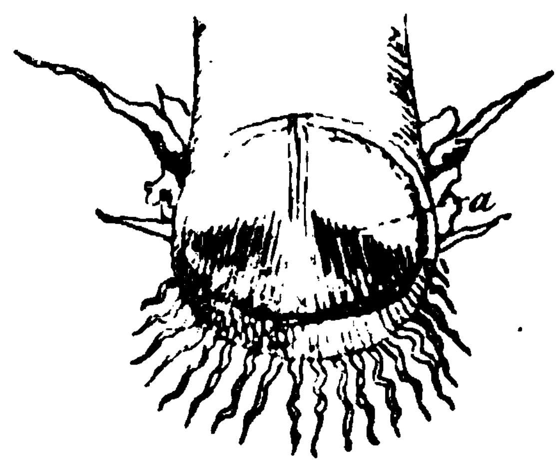



FIG. 6.

FIG. 4.

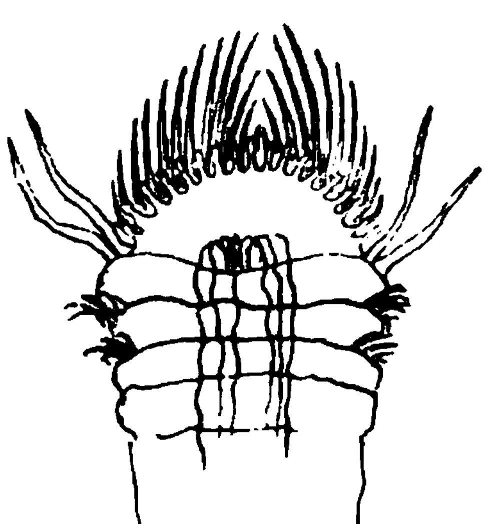


FIG 7.

FIG. 8.

FIG. 9.

R.J.H.G. Del.

Figs. 1 2 3.4. HERMADION ASSIMILE, M$^c$ Intosh.
Figs 5.6.7.8.9. PECTINARIA BELGICA, Pallas.

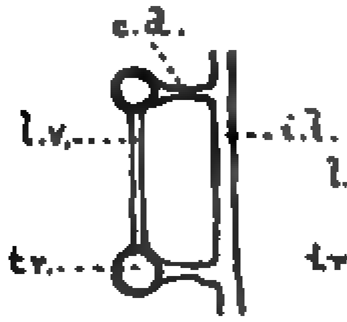


Fig. 1.

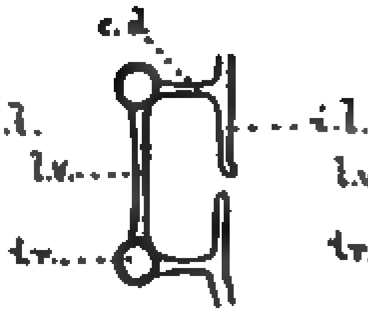


Fig. 2.

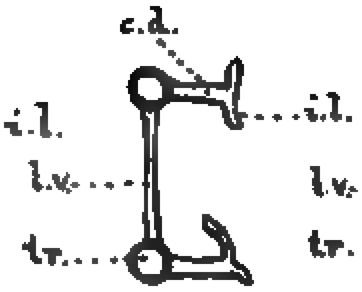


Fig. 3.

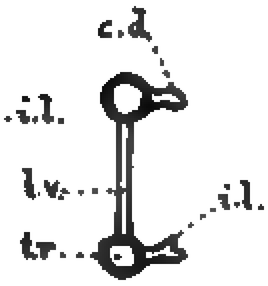


Fig. 4.

Fig. 5.

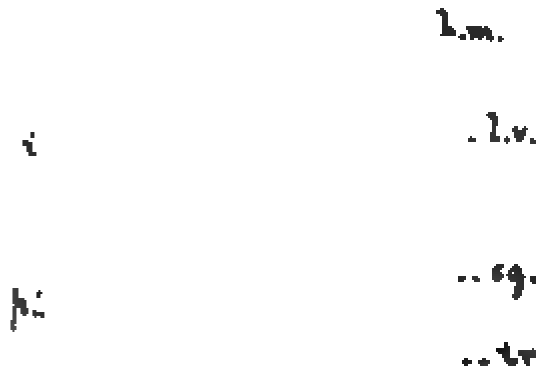


Fig. 6.

Fig. 7.

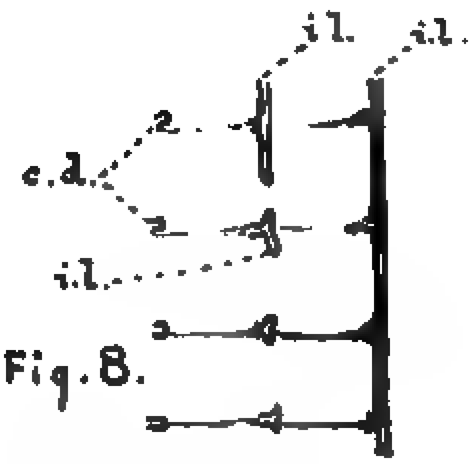


Fig. 8.

Fig. 10.

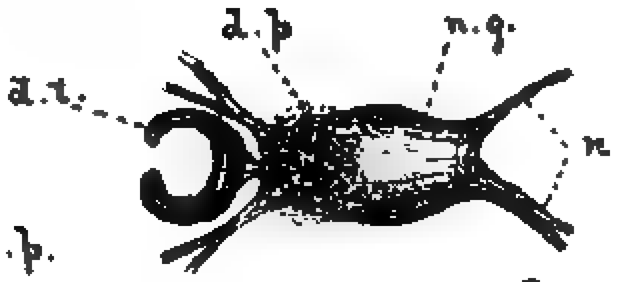


Fig. 9.

W. A. H.

Figs 1. 2. 3. 4. Internal longitudinal bars of various Ascidians.
Figs 5. 6. 7. 8. 9. 10. CIONA INTESTINALIS, Linn.

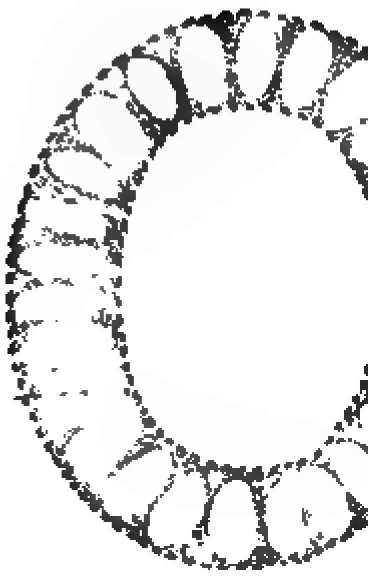



FIG. 2

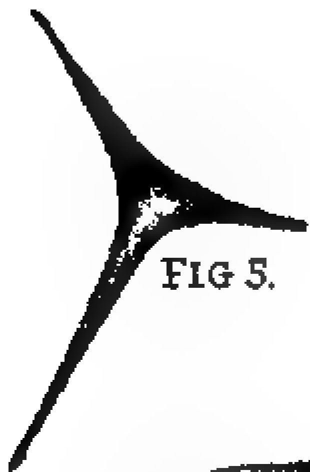


FIG 5.

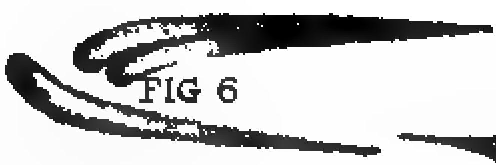


FIG 6

FIG 7.


FIG 4

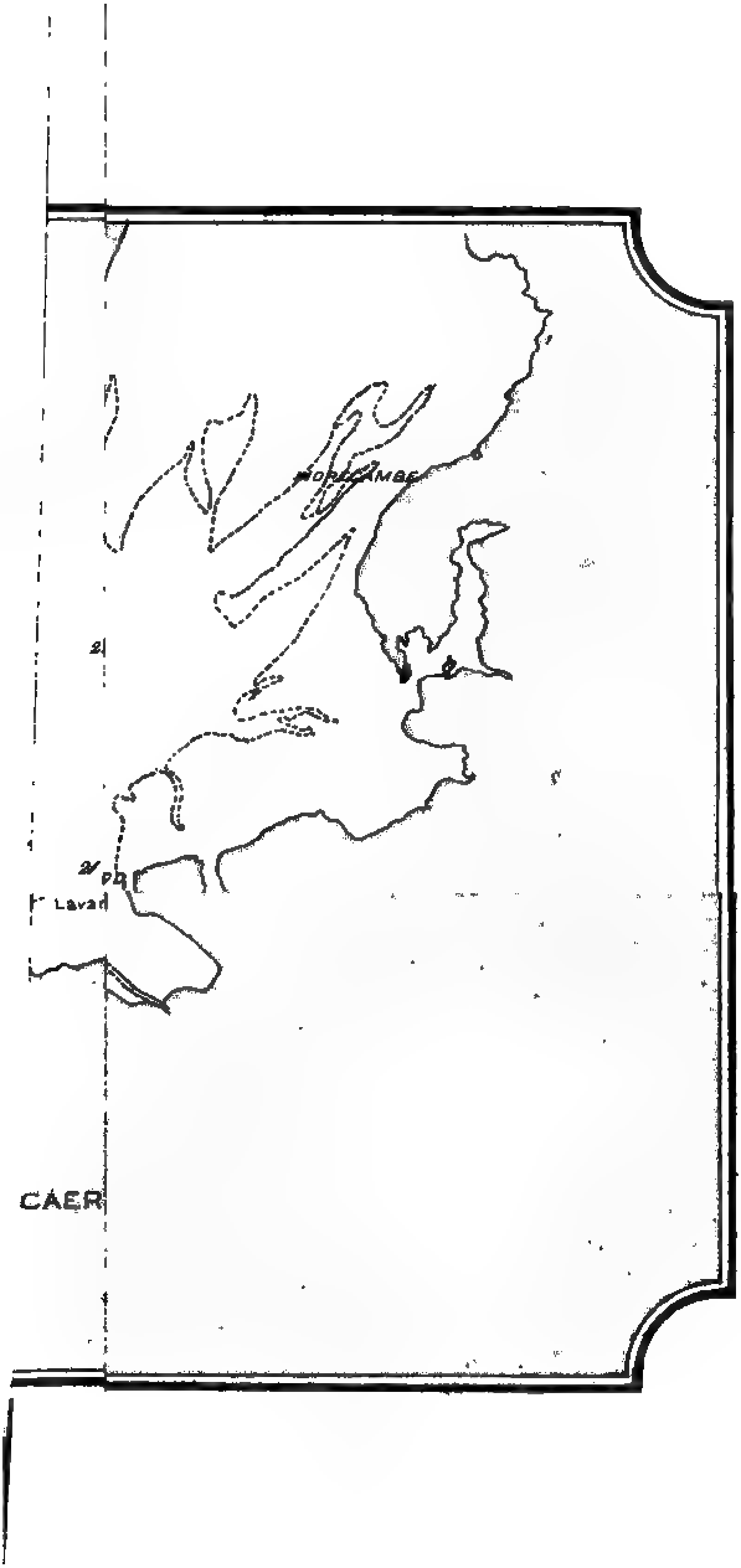
a
b
c

FIG 3.

e
f

R.J.H.G. del.

SYCANDRA ASPERA n. sp.



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